THE BRITISH JOURNAL OF TUBERCULOSIS

Vol. XXIX. January, 1935. No. 1.

EDITORIAL

OUR FUTURE PLANS

THE BRITISH JOURNAL OF TUBERCULOSIS is starting its twenty-ninth year with very considerable changes both of internal policy and external appearance. It will be noticed that the format has been altered, that a new and much clearer type is being used which it is hoped will be an improvement from the reader's point of view, and that the cover has been modernised and brought up-to-date.

As regards the content of the Journal, it has been decided to make it more clinical and to include in each number a clinical case, an essay on some subject of interest and a consultation. For this number Professor Lyle Cummins has written an article on the factors which tend to make pulmonary tuberculosis so acute in young women, and for the next number Dr. Armand-Delille is writing on the difference between childhood and adult tuberculosis and their causes.

The introduction of a series of "consultations" is a new feature. In this number the first of this series appears, and concerns a case which is by no means uncommon but the treatment of which presents many difficulties. Dr. R. A. Young discusses the case and gives his opinion as to the best treatment. In our next number the consultation will be undertaken by Dr. Amrein of Arosa. We hope there will be suggestions about treatment and criticism as to past management of these cases, and we shall be glad to receive notes of any cases readers may wish to send for consultation.

It is important to put on record an unusual case or one of special clinical interest, and we shall welcome an account of any such case which one of our readers might come across. We believe that the complication of artificial pneumothorax published in this issue is the first of its kind that

has been recorded, and it would be of great interest to know if any of our readers have met a similar case.

Another new feature is the introduction of abstracts from current literature on some special subject, and in this number we deal with allergy and immunity.

We present this new volume to our readers in the hope that it will be received with their approval and that they will co-operate with us by sending original articles, notes of clinical cases or correspondence on matters of interest.

THE INFECTIVITY OF TUBERCULOSIS

The problem of reinfection in tuberculosis was the subject of the address with which the Tuberculosis Association opened its new session. The ancients regarded tuberculosis as infectious, but of recent years there has evolved a school of thought which maintains that adult tuberculosis is a late manifestation of a childhood infection and some go as far as to deny the possibility of reinfection. For this view Koch's phenomenon, or rather the misunderstanding of it, is largely responsible, and it seems a dangerous doctrine to those who believe that, provided the infection is sufficiently large, active clinical disease can originate in anyone, child or adult, whether or not they have previously been infected.

Is it safe to allow those with a positive tuberculin test to live in close and constant contact with a consumptive member of the household? If this view is held, all contacts should be tested with tuberculin and the non-reactors removed from the infected household. The reactors would then be divided into two groups : those with active disease, who should be sent away for treatment, and those with no active disease, who should be allowed to continue their usual activities and continue to live in the infected house.

It is, however, generally believed that reinfection can occur and that the reactors as well as the non-reactors should be protected from the risk of contracting tuberculosis from a contact. This can best be done by removing the patient to some institution whilst his sputum contains tubercle bacilli. It is not always possible to do so, however, largely because pulmonary tuberculosis is a disease of such long duration that residence at home must form the chief part of a consumptive's life. Other members of the household should, undoubtedly, be kept under supervision, and a physical examination cannot be considered complete without radiography. The

cost of thorough supervision with X-ray examinations would be very great, and the possibility of avoiding them in the case of individuals who gave a negative tuberculin test was recently considered by the Joint Tuberculosis Council, who have in preparation a report on the whole problem of contact examination. The value of an isolated examination is to detect a carrier, possibly some elderly member of the household who is supposed to have chronic bronchitis. This comes under the heading of prevention. The second object of contact examination is the cure of the individual by detecting the disease in its early stages. It is obvious that for this purpose an isolated examination is not sufficient and that frequent re-examinations are necessary, as the onset of tuberculosis is often insidious. It was found in Lancashire that the incidence of tuberculosis was 53 per thousand amongst selected contacts who came for examination because they had some suspicious symptom such as debility or cough, whereas the incidence in Lancashire for the general population is 4·19 per thousand. No doubt it is impossible to avoid some sort of selection in the examination of contacts, but these figures point to the advisability of using every endeavour to get a complete examination of all contacts and not only those who have developed symptoms. If the individual continues to live in contact with the patient, repeated examinations with radiography seem to be necessary if the supervision is to have any value at all. The matter is one of considerable importance, and we await with interest the publication of the report of the Joint Tuberculosis Council.

PROBLEMS IN APPLIED MEDICINE

THE PROBLEM OF THE ACUTE PULMONARY PHTHISIS OF YOUNG FEMALES

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That there is a tendency to a high phthisis death-rate amongst young females is generally admitted. M. Greenwood,[1] in 1919, notes " the nearly uniform increase of the proportionate mortality (phthisis) at ages fifteen to twenty, in the great industrial towns," manifested by the female sex, and J. Brownlee,[2] in the previous year, called attention to the curious tendencies to differ as to the age of highest death-rate shown by males and females in these islands. " The maximum of the young adult type in females," he writes, " is at a later age than among males, while the opposite holds for the middle-age type. There is a very great difference between the amount of phthisis at high ages, the analysis showing that there is three times as much old-age phthisis among males as among females."

The Registrar General,[3] in his statistical review for 1931, gives figures which allow of the following tabulation:

Mortality from Pulmonary Phthisis per Million at Certain Ages; for Males and Females.

Age Groups.	*Males.*	*Females.*
0-4	110	92
5-9	52	51
10-14	79	176
15-19	599	976
20-24	1,032	1,236
25-29	1,094	1,179
45-49	1,616	563
50-54	1,515	535
65-69	1,618	534

It will be seen that, while at the earliest ages the death-rates, very low in actual numbers, are somewhat similar for the two sexes, males being, however, slightly in excess, the female death-rate becomes markedly higher than the male in all succeeding quinquennial periods from ten to twenty-nine. In contradistinction to the findings of Brownlee in the earlier observation already quoted, it will be noticed that the maximum for young adult females now falls in the twenty to twenty-four period, that for males coming later. The remarkable differences noted by Brownlee, however, are still clearly visible in late middle and old age, the male phthisis mortality being nearly three times as great as that of females. Differences at the middle and late age periods appear to result from the operation of factors inherent in industrial life, since they are not nearly so great in agricultural communities.

Whether in the town or country, the life of the average female, from marriageable age onwards, is spent under the more or less sheltered conditions of the home, whereas the exposure to risk of out-of-doors infective contact, negligible for the agricultural worker in his daily task, is very much greater in the case of males than in the case of females in urban life and industry. Added to this, there is the stress of earning, not for himself only, but for his wife and family, and the constant anxiety to hold on to a job even if advised to stop on medical grounds, which differentiates against the male in respect of resistance to infection in our great cities, just where we find the sharpest contrasts in the late phthisis mortality in relation to sex.

The object of this paper, however, is not to discuss the differences at the later age groups, but those earlier differences which justify the view that there exists, during late childhood, adolescence, and young adult life, a special liability of the female sex to acute progressive pulmonary phthisis. It is true, both of the general and the tuberculosis mortality, that boys die in relatively larger numbers than girls in infancy and early childhood; the difference being, of course, more manifest when we consider " tuberculosis, all forms," than when we confine our attention to pulmonary disease. But why is it that the situation is reversed from ten years onwards?

In an attempt to consider this problem, the author,[4] in 1923, laid stress on the special disabilities, both economic and physiological, to which females are exposed as compared with males. For his views on this side of the question the original paper may be consulted, as it expresses opinions which have not changed in the eleven years which have elapsed since it was written. During the period in question, however, certain observations, initiated round about 1923, have matured sufficiently to permit of analysis; and these may, perhaps, serve as a basis for a reconsideration of the problem from a new angle.

In a paper on "The Significance of Variations in Clinical Type in Pulmonary Tuberculosis,"[5] published in 1926, a preliminary analysis was attempted of some three thousand case records collected in Wales through the medical staff of the Welsh National Memorial Association, all new cases being entered on specially arranged "enquiry cards," which set forth not only the age, sex, family history, and details of infective exposure, if any, but also the actual clinical status of the patient when first seen, as expressed in a tripartite classification devised for the purpose of the enquiry. With the help of his secretary, Miss K. L. Gough, and through the kind co-operation of his friends and colleagues, the author has since been enabled to follow up the subsequent fate of a large proportion of the patients for whom "enquiry cards" were filled up from eight to ten years ago, and it is thus possible to abstract from the records certain facts bearing upon the problem of acute phthisis in young females as the condition is met with in Wales. Let it be said at once, however, that the problem is not by any means confined to Wales. All those with experience of tuberculosis in the south and west of Ireland, or perhaps one should say Ireland as a whole, and all who have practised in the highlands and islands of Scotland are familiar with this most tragic of the tragedies of tuberculosis. The sad little verses, penned by Dr. R. D'Alton Williams in Dublin more than a hundred years ago, are still exemplified in many a victim of acute phthisis today, especially in the west and along the Atlantic shores of these islands. The lines are as follows:

"From a Munster Vale we brought her,
From the pure and balmy air;
An Ormond peasant's daughter
With blue eyes and golden hair.
We brought her to the city
And she slowly faded there;
Consumption has no pity
For blue eyes and golden hair."

Is this mere sentimentality? By no means. It is just as true today as a hundred years ago, though, happily, less common.

Quite recently the author demonstrated three such cases to his class in a hospital near Cardiff, two children of fourteen and one of fifteen years; all three touchingly beautiful, with the tender complexions, bright eyes, and the long eyelashes so often associated, rightly or wrongly, with the consumptive state; one with a sister ill with tuberculosis, another who had lost her father from the same disease a year ago, the third with no history of family contact, but who had been working, since leaving school, in a glove factory, where she may well have encountered infection, all unconsciously, amongst her companions.

How does this rapid phthisis start? All three had been well, to outward seeming, until last summer, though one of them, the little girl whose father had recently died, was stated to have been a weakling in early years. In all, the disease had developed suddenly, after a prolonged cold or an influenzal attack; all three were febrile even at rest; in all, the lung disease appeared to be bilateral, though more marked on one side than the other; and pneumothorax had already been induced, with good results, in the eldest of the three, and was contemplated in the others. In spite of their early detection and immediate admission to hospital, the ultimate prognosis appeared to be very bad in all of them; the X-ray pictures showing the ominous soft cotton-wool-like shadows and the indefinite necrotic cavitations that we have come to associate with progressive phthisis.

How long do such cases last? And are they more rapid in females than in males? Commoner they certainly are, since, out of 1,981 acute phthisis cases in our records, 1,056 were females and only 925 were males; and young they were, as no less than 73 per cent. were between the ages of ten and twenty-nine years. Some idea of the average survival period of the young adult type in Wales may be gleaned from the following table, in which males and females are compared:

ACUTE INITIAL PHTHISIS IN WALES. SURVIVAL PERIODS IN MONTHS FROM DATE OF ONSET TO DATE OF DEATH, IN 1,571 FATAL CASES.

Survival Periods {	*Under 6 Months.*	*6 to 11 Months.*	*12 to 23 Months.*	*24 to 35 Months.*	*36 and Over.*	*Total No.*
Sex:	*Per Cent.*	*Per Cent.*	*Per Cent.*	*Per Cent.*	*Per Cent.*	
Females ..	10	26	34	14	16	839
Males	17	21	30	12	20	732

It will be seen that, save in the "under six months" group, in which the males showed a higher proportion of deaths, probably through reluctance to consult a medical man when first feeling the effects of illness, the percentage of deaths was higher in the females up to three years, a larger proportion of males lasting on into the fourth and subsequent years; but the rate of progression of phthisis of the young adult type is seen to be extremely rapid in both sexes, and this in spite of the facilities for modern treatment offered by the Welsh National Memorial Association. It should be added, however, that much of the good work done in our Institutions is compromised by the return of the convalescent or semi-arrested case, often against advice, to home conditions little calculated to maintain the standards necessary for permanent recovery.

In his previous paper, already quoted, the author, after discussing the special dangers of intensive " home " contact to which young females are exposed in domestic work, wrote as follows: " But it is especially in their physiological stresses that females differ from males, and these differences are most marked just at the age-periods when the phthisis mortality of the sexes exhibits its greatest contrasts—that is to say, at the time of preparation for and assumption of sexual maturity, the child-bearing period, and the period of the cessation of the reproductive activity at the menopause."

A reference to the death-rates extracted from the Registrar General's Report at the commencement of this paper will show that, after the sexually indifferent period of early childhood, during which the sexes differ but little, and phthisis is exceedingly uncommon in both, the growing female, with her tendency to earlier maturity, comes, between ten and fourteen years, to exhibit a phthisis mortality which is over twice as great as that of the male. This tendency is continued through the emotional years of potential or actual mating and the early child-bearing period; but is finally quite lost, giving place, in fact, to a marked advantage of the female as compared to the male, in phthisis fatality, during the years just prior to and after the menopause, with the consequent damping down of the fires of sex-life.

With these facts in view, it is tempting to invoke, as an explanation of the phenomena observed, the action of the endocrine system so closely bound up with the development as well as with the gradual waning of sexual maturity and activity. There is some evidence to support this assumption, in connection with which the observations of Webb, Gilbert, and Ryder,[6] in 1921, have much interest, but endocrines play a part in the life of both sexes, and are so mixed up with the whole physiological picture that their influence is as hard to differentiate as that of " environment " or any other great generality of human existence. It is therefore desirable to consider, in preference to such vague problems as the activity of the thyroid or the adrenals, organs common to males and females, some of those factors of stress and of limitation specially incident to growing girls and young women.

Through the work of Lissant Cox,[7] Midgley Turner,[8] and others, it has come to be generally admitted that the principal centres for the diffusion of tuberculous infection are those homes in which " open " cases are associated with unaffected relatives or domestics. The infected home is a focus of air-borne contamination to the inmates and, while some may escape actual disease, none can hope to avoid more or less intense infection.

When this point is conceded, it follows that females, on whom the care and service of the home especially devolve, are likely, at the more susceptible ages, to be exposed to risk. In the homes of the people it is the daughters,

not the sons, who tend the sick, " do out " the rooms, change the bedding, sweep the floors and walls—danger points, as has been proved by the experiments of Cornet[9] on the high infectivity of wall-sweepings for guinea-pigs—and in the homes of the well-to-do it is on the female domestic servant that these duties devolve. For a large section of the female population of these islands, domestic service is still the most easily available occupation; and the profession to which young women most readily turn, owing to the need to earn a living, or through natural inclination, is still the nursing profession, in which opportunities for exposure to infection may be frequent, though counteracted, to some extent, by the good hygiene of hospitals and sanatoria.

It is difficult or impossible to follow up the occupational liability of females, as is done for males in the Registrar General's Decennial Supplement, " in view of the intermittent and transitory character of much female occupation " (R.G. 1921). Greenwood, in the paper already quoted, speaks of " the limited length of the average industrial life of women consequent upon the fact that in any county a considerable majority of the female inhabitants marry and thereafter cease to figure as industrially employed persons." They may, indeed, cease to figure as such, but married women are, actually, industrially employed in an occupation which, hard in itself, since the care of a home and family is no light job, involves the special risks of pregnancy, childbirth, and lactation, as well as, in some cases, close and intimate association with an infected person. In the absence of official statistics bearing on occupational mortality from phthisis in females, it is interesting to attempt an analysis of a few main groups amongst the female cases followed up through the " enquiry cards " already referred to. The groups are necessarily small, but still the findings may be regarded as suggestive at least.

FATE OF ACUTE PHTHISIS CASES (FEMALES) FOLLOWED UP DURING THE YEARS FROM 1922 TO 1932, AS PERCENTAGES OF TOTALS.

Occupation.	*Died.*	*Worse.*	*I.S.Q.*	*Better.*	*Total Number.*
Nurses	58	4	8	30	24
Domestic servants	66	1	5	28	175
Housewives (less cases associated with childbirth) ..	76	2	2	20	387
Cases attributed to, or arising shortly after, childbirth	84	—	—	16	57

It will be seen, in this Welsh series, that married women, especially those in whom the onset of phthisis was associated with childbirth, fared very badly, while hospital nurses would appear to have come off best, and even domestic servants showed a lower mortality and a higher proportion of "better" than the married groups. This may, perhaps, be explained by the earlier medical attention which may be assumed to have been available for these unmarried females; the nurses being in a position to consult physicians connected with their institutions, and the domestic servants, doubtless, being sent to see the doctor when a persistent cough, or other symptom, bred anxiety in the mind of the mistress. That some such factor was operative is suggested by the following table, in which the stadium on first consultation with the Tuberculosis Officer is set forth for the same groups:

AMOUNT OF DISEASE WHEN FIRST SEEN, PER CENT.

Occupation.	*Minimal.*	*Moderate.*	*Advanced.*
Nurses	31	41	28
Domestic servants	27	42	31
Housewives	14	47	39
Childbirth cases	13	41	46

It may well be that the obligations of a wife and a mother restrained some of the patients in the married groups from seeking medical advice in time.

It is of interest to note that, among a group of thirty-three nurses—in nine the subsequent fate was not traced—thirteen, or 40 per cent., had been engaged in nursing tuberculous cases, four, or 12 per cent., had been nurses in mental hospitals where infection is known to be rife, and the remainder had been engaged in general nursing. Six of these nurses had, in addition, a history of familial exposure to an infected relative.

Amongst the domestic servants 35 per cent., in the housewives 22 per cent., and in the "childbirth" cases 37 per cent., had been in familial contact with infection. There was a history of marital contact in 7 per cent. of the married groups.

It is impossible to be blind, in considering these records, to the reiterated suggestion of the risk of exposure to infection as one of the principal factors underlying the high liability of adolescent and young adult females to acute phthisis.

Much importance may, and probably does, attach to physiological factors of a kind difficult to investigate at the present time, and the more complex emotional make-up of the female organism may play a part. The recent papers of Mary B. Eyre[10] on the association of emotional states and phthisis merit attention. But above all the author would lay stress on the risks

involved in domestic occupations at a susceptible age, and the intimate exposure to infection, which is unavoidable, in the homes of open cases, for those who tend the sick, sweep out the rooms, wash up, make the beds, and breathe the domestic atmosphere for the long hours when the men are out at their special tasks and away from home. Some belittle the importance of infection for adults. The author takes the view that the adolescent and the young adult female run a very grave risk when closely associated with an infective person in the home.

His thanks are due, in especial degree, to his colleagues, Dr. Enid Williams and Dr. P. K. Sen, who have helped to sort out " enquiry cards " and to compile tabular matter, and to his secretary, Miss K. L. Gough, who has kept up the records of cases for the past ten years. Without the kind help of the medical staff of the Association the collection of records would have been impossible.

REFERENCES

1. M. Greenwood: M.R.C. Special Report Series, No. 22, 1919.
2. J. Brownlee: M.R.C. Special Report Series, No. 18, 1918.
3. Registrar General's Statistical Review of England and Wales, 1931, Part 1, Medical.
4. S. L. Cummins: *Tubercle*, June, 1923, vol. iv., p. 385.
5. S. L. Cummins: *Tubercle*, May, 1926, vol. vii., p. 375.
6. Webb, Gilbert and Ryder: *Amer. Rev. Tuber.*, vol. v., 1921, p. 266.
7. G. Lissant Cox: The Fate of Young Children in Tuberculous Households. C. Tinling and Co., Liverpool, London, and Prescot, 1929.
8. H. Midgley Turner: *Tubercle*, 1931, vol. xii., p. 145.
9. G. Cornet: Tuberculosis. Translated by A. Stengel. W. B. Sanders and Co., Philadelphia, 1904.
10. Mary B. Eyre: *Tubercle*, April, 1933, vol. xiv., p. 300.

GENERAL ARTICLES

THE PLACE OF PHRENICECTOMY IN THE TREATMENT OF PULMONARY TUBERCULOSIS

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There is scarcely any form of surgical intervention in Pulmonary Tuberculosis which has caused so much controversy as the Phrenicectomy. We are here dealing with a moot point to the solution of which investigation, based upon a long period of observation, is essential. This is the motive which has encouraged us at Vejlefjord Sanatorium to undertake a review of 223 cases, all of which were operated on previous to July, 1932. Thus, the period of observation extends over a time of from two to ten years.

Our investigation is only concerned with the permanent results, as it is by these that the value of the method must be finally judged. At a cursory glance the material may appear very limited. But when it is considered that we have been able to trace the history of every individual patient and to collect exhaustive details concerning each case, it should be possible to arrive at a fairly trustworthy verdict.*

Classification of the Material.

Before the permanent results are reported it is necessary to leave out of account 70 of the 223 cases; they cannot be used to support an unbiassed conclusion for the following reasons:

(1) In 11 cases the operation was performed with non-tubercular lesions or lesions diagnosed as tubercular, but without T.B. in sputum.

(2) In 10 cases the operation did not cause any paralysis. In 4 of these the nerve was not found; in 2 it was found but resected in too short length

* A more precise and detailed report of this survey is given by Dr. Chr. Sinding-Larsen in the *Acta Tuberculosea Scandinavica*, October, 1934.

to permit of paralysis; in 4 cases the diaphragm continued its movements in spite of full evulsion of the nerve.

(3) In 49 of the 70 cases the Phrenicectomy was combined with other Collapse methods in such intimate association that it was impossible to determine the proper amount of credit to be given to the Phrenic operation. In this paper we desire mainly to appraise the value of this operation when it is performed by itself as an independent method of treatment. Its use in close combination with A.P., Thoracoplasty or Apicolysis will be discussed in a later survey of our large Collapse material.

Thus the material for true statistical analysis is reduced to 153 cases.

It is now found that a permanent positive result has been obtained in 55 *of these, the* 98 *remaining cases showing no positive indications of lasting beneficial results.*

The Effective Results.

These figures mean that only a little more than one-third of the cases have derived lasting benefit from the operation. This, far from being reassuring, leads to an unfavourable comparison with the results obtained by other forms of surgical treatment after a similar period of observation.

A more minute study of the 55 cases with positive results further reduces the apparent efficacy of the operation. Eleven of the patients had already shown such marked improvement before the Phrenicectomy was performed that one feels uncertain about the benefit accruing from the operation. In another 17 cases the patients continued to expectorate Tubercle Bacilli, and the whole question of improvement therefore became rather debatable.

This leaves only 27 cases where we have any right to say that the patients were healed as the result of the Phrenic operation. An individual study of these 27 cases shows that they represent the most localised and the least serious affections out of the total material examined. When it is remembered that all of these patients had been living under sanatorium régime both before and after the operation, and that many of them had received other forms of treatment (*e.g.*, Sanocrysin, Light treatment, etc.), one seems justified in thinking that it was in conjunction with these other methods, rather than by the evulsion itself, that the beneficial results had been obtained.

These facts verify the impression which had been steadily gaining ground in our minds during our twelve years' experience of the Phrenicectomy—namely, that the actual efficacy of the operation has been greatly exaggerated by many who have written about it.

This is not meant to be a wholesale condemnation of the Phrenic opera-

tion. Where definite indications are found, we believe some good may be achieved by Phrenicectomy. What we wish to protest against is its indiscriminate use even where no special indications are present.

A further examination of the "negative" group provides a forcible argument in support of this warning.

The Non-effective Results.

Here, too, the conclusions are the result of our deliberate and unprejudiced judgment of the 98 cases, with no lasting effect: 26 of them must be left out of consideration, as they had already shown very malignant or complicated developments. The operation was used as a last resort; it would therefore be unfair to debit the Phrenicectomy with the unfavourable result. In another 18 cases the operation had been performed elsewhere before the patients were admitted here; they came for further help by surgical or other forms of treatment. As these cases represent a particular group of non-effective results, they should not be used as basis for an unfavourable estimate of Phrenicectomy.

But the remaining 54 cases are a heavy weight on the debit side of this method. In all these cases the operation has reduced the respiratory function of the affected lung to a considerable degree, without any compensatory result This fact alone deserves much more attention than has been given to it by many who have written about it.

Moreover, it must be remembered that in most cases it is the healthy lower lobe which is disturbed in its function, while the affected apical area shows no evidence of benefit. This is in striking contrast to the favourable development of collapse therapy following the principle of selectivity. Any interference with the phrenic nerve *must* be considered to cause a contra-selective lung collapse in all cases where the affection is located in the apex.

Many authors maintain that the paralysis of the diaphragm acts equally effectively on the upper and on the lower lobe. This statement does not agree with our experience, and it is contradicted by the fact that basal or middle-lobe affections were found proportionally in three times as many of the successful cases we have examined as of the cases with negative results.

Another noticeable feature is that far from being an advantage to further surgical treatment (*e.g.*, partial Thoracoplasty), the preliminary Phrenicectomy appears to be a severe handicap to patients with apical cavernous affections. As will be described by our previous assistant, Dr. A. Rischel, in a compilation of all our cases of Thoracoplasty, partial Thoracoplasty

on the upper lobe is found to give a higher operative mortality and a lower percentage of " bacilli-free " and " fit for work " recoveries, when it is preceded by a preliminary Phrenicectomy than when it is not. Thus, it is evident that partial Thoracoplasty is deprived of some of its benefit, both immediate and remote, when it is preceded by a Phrenic Evulsion.

Indications.

The results of this investigation have made us very cautious with regard to the indication of Phrenicectomy, especially in apical affections. It is our advice to others not to be misled by its attractive features—viz., the technical simplicity and its slight demand on the patient's reserves. The use of the operation as a mere test of the patient's fitness for further operative treatment is, in our opinion, not at all advisable.

We consider Phrenicectomy to be indicated as an independent Collapse method only—

When Artificial Pneumothorax has proved a failure; *when* the lung affection is so located in the middle or lower lobe that this operation may be expected to have good results; and in apical affections only *when* Thoracoplasty must be considered impossible either because of the age of the patient or because he definitely refuses to undergo that operation.

Otherwise, we would advise against the Phrenic operation in all cases where a healthy lower lobe offers some real possibility of the continued respiratory function, which is connected with the diaphragmatic movement.

There may be cases where it will be difficult to decide whether or not a Phrenicectomy may be expected to help the patient and save him from more drastic and risky interventions. In such cases we now recommend to try the modified method of performing a preliminary and temporary crushing of the nerve. This leaves the way open for the re-establishment of the diaphragmatic movement or for the final paralysing of it by subsequent evulsion of the nerve, as may be found advisable in the light of the further developments of the case.

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By SIR HUMPHRY ROLLESTON,
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As the author of an early, probably the first, book by an Englishman dealing with pulmonary tuberculosis in 1654, which appeared thirty-five years before the better known work, *Phthisiologia | seu | Exercitationes | de | Phthisi* (1689, pp. 413), of his junior, Richard Morton (1637-98), the memory of Christopher Bennet (1617-55) should surely not be entirely forgotten. His *Theatri Tabidorum Vestibulum | seu | Exercitationes Dianœticæ | cum Historiis | et | Experimentis | demonstrativis | Quibus | Alimentorum respectu subactionis | & distributionis; Necnon Sanguinis & succi nutritii | innatantis, respectu qualitatis consistentiæ matu | ritatis, & circulationis vitia deteguntur | in Morbis plerisque; | Presertim Pthisi, Atrophia & Hectica*, per Christoph. Bennettum, M.D. (pp. 126), with his portrait as the frontispiece and, as was not uncommonly the custom in those days, a number of laudatory verses by his friends, came out in 1654; the dedication to Sir Francis Prujean (1593-1666), President of the Royal College of Physicians of London, bearing the date of November 26, 1653. It passed into a second edition two years later, with the altered title and the Latin form of his surname: *Tabidorum | Theatrum | sive | Phthisios, Atrophicæ, | & Hecticæ | Xenodochium.* Authore Christophero Benedicto, M.D. Collegii Londinensis Socio. Lond., 1656 (pp. 192). Dr. Martin Llewellyn (or Luellen) (1616-81), described by Munk as having " prosecuted his genius as much to physic, as before it had to poetry," who revised and saw this edition through the press, admitted that Bennet's Latin style was careless, but pleaded in extenuation that he was " more intent on things than on expressions." It was reprinted at Frankfort (1665), Leyden (1724, 1733, 1742), Leipzig (1760), and Venice (1761), and was translated into English in 1720, entitled *Theatrum Tabidorum: | or The | Nature and Cure | of | Consumptions, | whether A Phthisick, an Atrophy, | or an Hectic | with Preliminary Exercitations*, Lond. (pp. 236). Van Swieten (1700-72), a favourite and devoted pupil of Hermann Boerhaave (1668-1738) at Leyden, on whose aphorisms he brought out a commentary after thirty years spent on this pious labour, thought very highly of Bennet's book. According to J. F. Payne (1840-1910) in the *Dictionary of National Biography*, " its most valuable feature is the constant reference to cases observed and to dissections, not to authority, which gives his little treatise an honourable place among

the earlier examples of the modern method in medicine." The notice in the *Dictionaire des sciences médicales : Biographie médicale*, Paris, 1820, sounded a discordant note in the statement that his reputation was for a long time far in excess of its real value, for his book contained few exact observations or details of suitable treatment, many exaggerated hypotheses, and was written in an obscure style. Though from the number of editions brought out at Leyden his book would appear to have been popular there, it is said that Boerhaave in " some pleasant intervals with his pupils " spoke of Bennet as " the dealer in heteroclites " (nouns declined otherwise than in the ordinary manner).

Like Morton's much larger work, it dealt with various wasting diseases, and not exclusively with pulmonary tuberculosis, and had a pathological rather than a therapeutic standpoint. The preface of the English translation of the *Theatrum Tabidorum* (1720), sixty-five years after his death, gave the following account of how the book, which appears to have been intended to be a precursor of an expanded treatise, saw the light of day:

> " The Author of this Work was greatly eminent in his time for practice; particularly in the Distemper here treated of, for which he occurred to be fitted in an uncommon manner; being himself naturally Consumptive and with difficulty supported under it for many years together; so that he had not only great opportunities of being thoroughly acquainted with this disease from a long practice, but from a long experience of what passed within himself. Thus instructed, all his acquaintance, and the most eminent of the faculty in particular, were desirous for his writing up on the subject, and the following work seems to have been extorted from him by their importunities."

1655, the year of Bennet's death, saw the publication of *Healths Improvement: | or, | Rules | Comprizing and Discovering | the Nature, Method, and Manner of | Preparing all Sorts of | FOOD | used in this Nation. | Written by that ever Famous | Thomas Muffet, | Doctor in Physick.* " Corrected and Enlarged by Christopher Bennet, Doctor in Physick, and Fellow of the Colledg of Physitians of London " (pp. 296). The quaintly disarming preface began: " 'Tis not an itch to be in print, but my Profession to keep men alive, and when gone to recover and revive them, that hath induced me to this undertaking. Blame me not therefore for using means to raise our Author out of the dust and oblivion, wherein he was buried." It received the imprimatur of the President and Censors of the Royal College of Physicians of London, but was a gossipy account of maxims about diet, intended to be followed by a similar volume on " drinks," and was probably compiled about 1595, but never previously printed. Thomas Moffett, Moufet, or Muffet (1553-1604), a Cambridge graduate who obtained the doctorate of medicine at Bâle, was a naturalist, poet, Court physician, traveller, and Member of Parliament.

Christopher was the son of John Bennet and was born at Raynton in Somerset in 1617; he entered Lincoln College, Oxford, as a commoner in 1632 and took the degrees of B.A. (1634) and M.A. (1639). "Entering on the physic line," he graduated M.D. at Cambridge (1646), became a Fellow of the Royal College of Physicians of London in December, 1649, and was a Censor in 1654. He had practised for a short time at Bristol before settling in London, where he had a considerable clientele. He died of consumption on April 30, 1655, and was buried in St. Gregory's Church, near St. Paul's Cathedral. His portrait, engraved by P. Lombart (1620-81), is the frontispiece of his book.

Reference may perhaps be made to three other men of a similar, if not exactly the same, name as Christopher Bennet who have written on tuberculosis.

John Hughes Bennett (1812-75), a Londoner by birth, a student and professor of the Institutes of Medicine at Edinburgh, advocated in 1841, and popularised, the use of cod-liver oil in rheumatism and scrofula, which, however, had long been done by the fisher-folk in Scotland, and also in Manchester, where Thomas Percival (1740-1804) recommended it in 1783. Hughes Bennett's claim for priority was contested by C. J. Blasius Williams (1805-89), physician to University College Hospital, and in 1846-8 the first President of the old Pathological Society of London, which he is said to have endowed with the motto "Nec silet Mors." In 1853 Bennett recommended a somewhat modified form of open-air treatment, but here again he had been anticipated, by George Bodington (1799-1882) in 1840, and was not the ardent apostle of fresh air that Henry MacCormac (1800-86) of Belfast was from 1852 onwards.

John Henry Bennet (1816-91), a London gynæcologist, broke down with pulmonary tuberculosis in 1859, but cured himself by residence at Mentone on the Riviera, and wrote a number of pamphlets on the subject of its climatic cure; in one of them, in 1866, long before the open-air treatment was practically recognised in this country, he remarked, "Theoretically the value of pure air—of atmospheric food—is universally accepted by the medical profession; practically it is all but universally neglected," and, while insisting on the importance of rest, spoke of some patients who had "walked themselves to death." He finally retired from London in 1875 and died on July 28, 1891, at La Bollène, Alpes Maritimes.

James Risdon Bennett (1809-91) was one of the first to introduce the use of the stethoscope into this country; he was appointed physician to the City of London Hospital for Diseases of the Chest when it opened in 1848, was physician to St. Thomas's Hospital, and President of the Royal College of Physicians of London from 1876 to 1881.

ASSMANN'S FOCUS

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THE situation in the lungs of the early tuberculous focus in adults has long been the subject of controversy. At the beginning of this century most observers were of the opinion that adult tuberculosis originated in the apices, and physical examination certainly appears to confirm this. When radiology was applied to the diagnosis of chest diseases it was soon noted that radiographs invariably revealed a more extensive lesion than was suspected clinically, and that apparently early cases of apical disease showed extensive infraclavicular involvement.

In 1925 Assmann drew attention to a solitary infraclavicular opacity which he had observed in young adults with slight symptoms, no physical signs and a definite history of contact with tuberculosis. He suggested that this opacity might represent the early tuberculous focus of adults, and the subsequent development of open tuberculosis in many of his patients substantiated this view.

In 1926 Redeker confirmed Assmann's findings, but went much further and stated definitely that the opacity described by Assmann represented a tuberculous infiltration with a perifocal inflammatory reaction "in a lung not previously affected by phthisis." The infraclavicular opacity and its progression and regression have since been investigated by workers in all countries, and while few are as dogmatic as Redeker, it is now generally recognised that the so-called Assmann's focus is a frequent manifestation of early pulmonary tuberculosis. In many cases a local pulmonary reaction surrounds and often obscures the focus. There is considerable divergence of opinion as to the nature of this so-called perifocal reaction, and in this paper only the sharply defined focus as originally described by Assmann is considered.

The focus has been observed most often in young adults, but there is one case on record at the age of seven years, and I have seen it in a woman of fifty-seven who subsequently developed open tuberculosis. The usual symptoms associated with the focus are slight pyrexia and malaise, and

often there is a story of recent influenza from which the patient has not completely recovered. In three cases sent to me for X-ray examination and showing a typical focus sudden hæmoptysis was the first symptom, and in one of these tubercle bacilli were found in blood-stained sputum the day after the attack. It is of interest that none of these three cases had pyrexia. A definite history of contact can be elicited in many cases. Arborelius, who carried out an exhaustive investigation on the incidence of the focus in young recruits, was able to establish a history of contact in most cases. Assmann's original patients were nearly all doctors or nurses, and he mentions over-work and under-nourishment, in addition to contact with tuberculous subjects, as predisposing factors. More recently, excessive exposure to brilliant sunshine has been cited as a predisposing factor.

The focus appears radiologically as a round opacity in the right infraclavicular region. It is occasionally seen in the right middle and lower lobes and in the left infraclavicular region, but I can find no record of its occurrence in the left lower lobe. It varies in size considerably and may be as small as a pea or as large as a half-crown. There is no relationship between the size of the focus and the symptoms associated with it. The opacity is usually well defined and homogeneous, but it sometimes has a ragged or serrated outline and not infrequently the centre is denser or more translucent than the periphery. The maximum density is about equal to that of the hilar shadow and is never as great as the density of the heart or aortic shadows. Lateral views show that the opacity is in the posterior parts of the lung, irrespective of the lobe affected. In its most frequent site in the right upper lobe the focus is always found in an area corresponding to the dorsal subapical or apical branch of the eparterial bronchus. Special consideration is attached to this situation by German workers, but this point will be considered in detail later.

The evolution of an Assmann's focus as observed radiologically is very varied. In cases where the disease progresses the centre of the opacity becomes slowly more translucent until eventually a typical cavity is formed. While this change is taking place the neighbouring striation increases, due to a combination of hyperæmia and bronchitis, and small comma-shaped opacities develop along the bronchial striations.

In favourable cases the opacity alters in one of three ways:

(1) The opacity becomes less well defined, less homogeneous and less dense, and eventually completely disappears. For many months, however, there may be a small area of increased vascularity at the site of the lesion.

(2) The opacity becomes denser and more sharply defined, and over a long period becomes smaller. It maintains its rounded outline throughout,

and a zone of increased translucency due to compensatory emphysema surrounds it.

(3) Deposits of calcium appear in the centre of the focus, which slowly shrinks and often becomes oval in outline. Complete calcification is usually a matter of years, but the first spots of calcium may be visible within four or five months.

It is often found that the evolution of the radiological lesion does not tally with the clinical evolution. This gives rise to no difficulty when an obvious cavity is developing, but there are certain cases in which the radiographs suggest that the lesion is clearing up, while the clinical findings are definitely those of active disease. The explanation of this discrepancy is the fact that minute foci are present in the vicinity of the focus, and these are too small to be detected radiologically.

The differential diagnosis from the radiological point of view resolves itself into a study of the nature of the isolated round opacities which occur in the lungs. Belot and Peuteuil have published an excellent monograph on this subject, and describe no less than nineteen diseases which can produce intrapulmonary round opacities. For practical purposes, however, those which most frequently simulate Assmann's focus are as follows: (1) Pulmonary abscess; (2) primary carcinoma; (3) secondary carcinoma or sarcoma; (4) pulmonary thrombosis; (5) hydatid cyst; (6) interlobar empyema.

(1) Both clinically and radiologically it may be impossible to differentiate between a lung abscess and an Assmann's focus. Both may be round and well defined, both may remain *in statu quo* over a considerable period of time, and both may be surrounded by an ill-defined perifocal reaction. Unless some positive evidence, such as tubercle bacilli in the sputum or expectoration of pus, is forthcoming, the diagnosis must be based on the history and symptoms. In one obscure case I have seen postural drainage result in expectoration of several ounces of pus with almost complete disappearance of the radiological opacity in forty-eight hours.

(2) Primary carcinoma of the lung is occasionally seen as a round, well-defined opacity about the size of a florin. The disease can, of course, originate in any part of the lungs, but many believe that the right upper lobe is a favourite site. I have seen two cases of this nature in the right upper lobe, and in both the main opacity could not be differentiated from a tuberculous focus. In both cases, however, there was a fairly dense, ill-defined striation running from the tumour to the hilum shadow. Striation of this nature has not been described in the tuberculous lesions.

(3) An isolated metastasis from carcinoma or sarcoma cannot be differentiated from an early tuberculous focus of the Assmann type. Generally,

a malignant metastasis is denser and better defined than a tuberculous focus, but this is a very unsafe guide. Malignant metastases tend to be

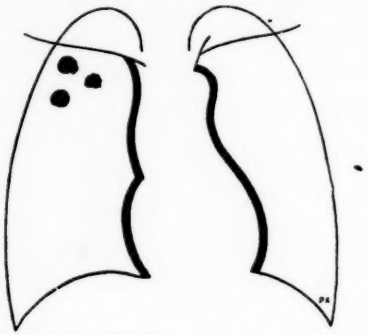

FIG. 1.—VARIATIONS IN THE APPEARANCES OF ASSMANN'S FOCUS.

(Drawn from radiograph.)

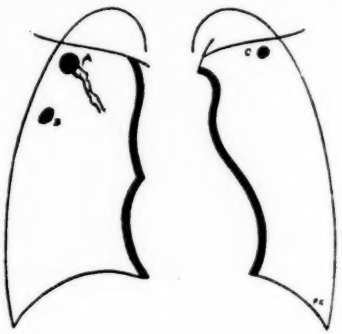

FIG. 2.

A. Primary carcinoma of the lung; B. solitary metastasis from hypernephroma; C. pulmonary thrombosis.

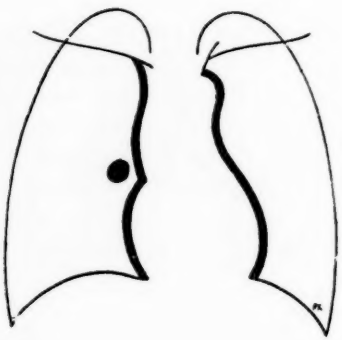

FIG. 3.—ROUND FOCUS IN THE RIGHT HILAR REGION WHICH MAY BE A TUBERCULOUS FOCUS, A MALIGNANT LESION OR AN INTERLOBAR EMPYEMA.

See lateral view in Fig. 4.

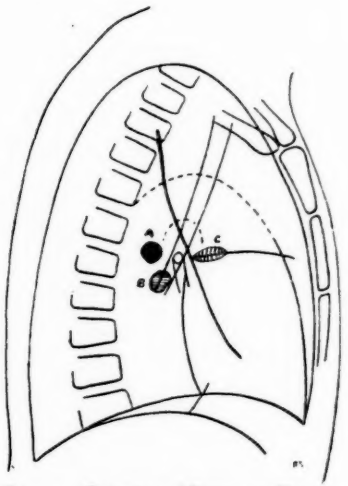

FIG. 4.—LATERAL VIEWS OF FIG. 3 DRAWN FROM RADIOGRAPHS.

A. Assmann's focus in apex of lower lobe; B. primary carcinoma of lower lobe bronchus; C. small interlobar empyema.

multiple and scattered in all parts of the lungs, but there are many exceptions to this, and it is by no means certain that the tuberculous focus is

always single. I have seen three foci, all of the same size and density in the infraclavicular region, in a nurse looking after a patient with advanced phthisis. Her only symptom was malaise, and it was difficult to believe from a study of the radiographs that these foci had not all developed at the same time. Many radiographs of different density failed to show any abnormality of the lung tissue between the three foci.

The presence of a primary malignant tumour is not conclusive evidence. This was well illustrated by a case described (not published) by Bull at a meeting of the Royal Society of Medicine. Bull's patient was a middle-aged woman who had a carcinoma removed from the gastro-intestinal tract, and subsequently developed a single round opacity in the right upper lobe. This opacity broke down to form a cavity, and tubercle bacilli were then found in the sputum.

In the differential diagnosis between tuberculosis and metastasis the patient's symptoms are the best guide. Very often pulmonary metastases are found during a routine search and no pulmonary symptoms are present. Tuberculous foci are invariably associated with symptoms either local or general.

(4) Pulmonary thrombosis occurring as a complication of cardiac disease is easily recognisable both clinically and radiologically. Quite apart from cardiac affections, a pulmonary thrombosis may be the first or only manifestation of a disease now known as thrombophlebitis migrans. The etiology of this disease is still obscure, but it is by no means rare, and its pulmonary manifestations closely simulate many of the common primary lung conditions. In the typical case the patient, while undergoing treatment for phlebitis of the veins of the leg, complains of pain in the chest and slight dyspnœa. The same evening there is usually slight pyrexia and very often hæmoptysis. There are, undoubtedly, many cases in which the phlebitis of the legs is absent and the whole course of the disease is pulmonary.

A large pulmonary thrombosis produces a vague ill-defined opacity occupying the greater part of a lobe. It is always associated with pain, pyrexia and hæmoptysis, and is very difficult to diagnose from lung abscess and lung carcinoma. A small pulmonary thrombosis produces a small round opacity, very well defined and with a definite tendency to occur more often in the infraclavicular regions than in any other parts of the lungs. Radiologically the opacity is indistinguishable from an Assmann's focus, and as the symptoms and physical signs produced by a thrombosis are entirely dependent on its size, it follows that with small thromboses these are slight and also simulate tuberculosis. No single method of examination can solve a problem of this type. If the lung symptoms are preceded or accompanied by phlebitis of the leg veins, the lesion in the chest is most

likely a thrombosis. If the disease is confined to the respiratory tract, repeated X-ray examinations at intervals of ten days will give decisive information. Irrespective of treatment, a pulmonary thrombosis tends to clear up very rapidly, and this process is easily demonstrable by radiography. I have seen six cases of this nature, and in all of them the lesion had either vanished or diminished in size by two-thirds over a period of a fortnight. On the other hand, slowness of evolution is a characteristic of tuberculosis. Fig. 2 *c* is from the radiograph of a young man who had a history of two previous attacks of phlebitis of the leg veins associated with pulmonary symptoms. A third and mild attack of pain and swelling in one leg developed very suddenly and passed off in a day or so. Some days later he had slight dyspnœa, pain in the chest, and coughed up blood. There were no physical signs in the chest, but X-ray examination showed what appeared to be a typical Assmann's focus in the right infraclavicular region. In view of his history the chest was again X-rayed after a week, and the infraclavicular lesion had practically disappeared. I have seen similar rapidity of resolution in pulmonary infarction following appendicectomy.

Pulmonary thromboses, either isolated or in association with phlebitis elsewhere, have not yet been thoroughly investigated, and it would seem wise, in view of our present limited knowledge, to X-ray all suspected Assmann's foci at short intervals before instigating active tuberculous treatment.

(5) Primary hydatid disease of the lung is not easily confused with tuberculosis. An hydatid cyst of the lung is always very sharply defined, and has a homogeneous density which is usually greater than that of a tuberculous focus, and is not infrequently more dense than the heart shadow. Hydatid cysts are generally larger than tuberculous foci, and tend to be situated in the lower rather than the upper lobe. They seldom give rise to pain, pyrexia or hæmoptysis unless secondary infection has supervened, and then the clinical picture is much more like abscess than tuberculosis.

(6) A small interlobar effusion may cast a round shadow similar to an Assmann's focus, and the symptoms of both conditions may be the same. Examination in the lateral view shows that with interlobar effusion the shape of the opacity alters and localisation to the fissure is easy.

There are many theories as to the method of infection in true tuberculous foci of the Assmann type. Redeker's assertion that it does not occur in a lung previously affected by phthisis cannot be substantiated. I have seen it occur and actively progress in patients with multiple calcified foci in both lungs. Assmann states that the lesion must be a secondary infection, as swelling of the mediastinal glands has not been described in association with it. He holds that glandular swelling must accompany all primary

tuberculous infections. This cannot be contested, and in the few cases which have come to autopsy there was no evidence of recent glandular involvement.

Both Assmann and Redeker are of the opinion that the focus is most often an exogenous aerogenous infection. Their views are based largely on the work of Tendeloo, who states that expiratory and lymphatic movements are weakest in the dorsal subapical regions. It is in these regions that the focus is most frequently seen. While not denying some mechanical factor being responsible for the frequency of the focus in this region, this argument appears weak, because most of the common infections of the lung, which we know to be inspiratory, are basal or paravertebral in situation. Broncho-pneumonia is a classical example.

Assmann himself records two cases of an infraclavicular focus developing and progressing secondary to post-mortem " tubercles " on the hands. In these two cases the lung lesions can only be explained on the basis of hæmatogenous dissemination.

We know that malignant metastases reaching the lung via the blood stream produce round opacities, and that small thromboses and infarcts produce similar round opacities. The large wedge-shaped infarct or thrombosis is only seen when a vessel of the first or second degree is plugged. We also know from lipiodol examination that the lung lobules are triangular in shape, so that one would expect an inhalation infection of a lobule to produce a triangular opacity. The invention of some substance which will render the pulmonary vessels opaque to X-rays will go far towards solving this problem: data gained from our present chest radiographs is very inconclusive, but such facts as can be deduced from them suggest that round intrapulmonary opacities reach the lungs via the blood stream.

REFERENCES

ASSMANN, H.: Das Frühinfiltrat, *Zentralbl. f. Inn. Med.*, 1932, p. 450.
ARBORELIUS: Clinical Studies in Adult Tuberculosis. Issak Markus, Stockholm, 1930.
BELOT AND PEUTEUIL: Les opacités arrondies du thorax, *Journ. de Rad. et d'Elect.*, vol. xiv., October, 1930.
REDEKER: Über das Frühinfiltrat, *Deutsch. med. Woch.*, 1927, vol. cliii., p. 97.
TENDELOO: Studies on the Course and Occurrence of Lung Diseases. J. F. Bergmann, Munich, 1931.

THE TUBERCULIN TREATMENT OF PULMONARY TUBERCULOSIS

By HALLIDAY SUTHERLAND,
M.D.

The value of tuberculin in the treatment of many non-pulmonary tuberculous conditions is generally recognised. In tuberculous adenitis prior to caseation tuberculin is the specific remedy. When caseation has occurred and the surgeon has removed a chain of glands, a course of tuberculin should be given, because the finest scalpel cannot remove all tubercle bacilli from the body. Again, in tabes mesenterica, in ocular tuberculosis, and in tubercle of the kidney the value of tuberculin is not in doubt. In point of fact, in cases where both kidneys are involved, tuberculin is the only treatment. In pulmonary tuberculosis many workers have obtained excellent results. Others have failed to obtain good results, and have concluded that tuberculin is worthless in tubercle of the lung. As one who believes in tuberculin, I shall endeavour in this article to give a plain statement of the value and technique of this treatment in lung cases.

Selection of Cases.

Tuberculin may be used in any afebrile case, irrespective of the extent of the disease. If the patient has the mild intermittent pyrexia of early disease—normal temperature in the morning and a daily rise to 99° F., or over, in the late afternoon or evening—this must be controlled by rest in bed before tuberculin is given. This rule is all the more applicable to the continuous pyrexia of tuberculous broncho-pneumonia, and to the severe intermittent pyrexia of secondary infection. Tuberculin will not resuscitate the dying. The ideal case is where early symptoms—such as dry cough, loss of weight and appetite—are associated with suspicious X-ray signs, and the diagnosis has been confirmed by the subcutaneous tuberculin test. In such cases we may confidently expect that within a year or eighteen months the patient will be immunised to a dose ten thousand times greater than that which caused the diagnostic febrile reaction. He will give no reaction to a dose which might seriously endanger the life of a healthy adult.

Moreover, as his immunity rises, symptoms and signs disappear. That is what tuberculin can do, and in many cases without the patient leaving work or going to a sanatorium.

Let it be noted that tuberculin gives the best results, and at a fraction of the cost, in those very cases which most sanatoriums are desirous of admitting. If tuberculin treatment can do as much or more than sanatorium treatment, then obviously it would be better that the febrile cases, needing rest and then graduated activity, should be sent to sanatoriums until they have become suitable cases for tuberculin treatment at home. In that way our existing organisations could cope with the disease. That is a point which I hope every reader will weigh at the end of this article.

Choice of Tuberculin.

Professor E. R. Long, of Philadelphia, has given the most comprehensive definition of tuberculin:

> "Literally hundreds of preparations on the present or past market of medical remedies and diagnostic agents have been called 'tuberculin.' They are prepared from the broth on which tubercle bacilli have been grown—heated, unheated, precipitated, filtered, evaporated, boiled, dried or distilled; or from tubercle bacilli—alive, dead, pulverised, 'puffed' in a vacuum like wheat, squeezed in a press until the juice squirts, frozen in liquid air, subjected to superheated steam, dissolved in their own digestive juices, macerated in oil, defatted, benzoylated, precipitated with iron, iodised, oxidised, reduced or subjected to other varieties of physical, biological and chemical violence not equalled in mutilative ingenuity since the Spanish Inquisition. These 'tuberculins' have two factors in common. They are originally derived from a culture of tubercle bacilli, and they all contain a substance to which the tuberculous body is allergic. All are relatively harmless to the normal animal, and all excite fever and cause prostration when injected into the tuberculous. All cause a local inflammation when injected into the skin of a tuberculous animal or person."[1]

In 1915 I boiled a gramme of washed dried tubercle bacilli in chloroform, using a reflux condenser. After six weeks' boiling the experiment was interrupted, owing to the exigencies of the war, and the bacilli formed a scum on the surface of the chloroform. The mixture was bottled and set aside. Five years later the mixture had become an opalescent fluid—a solution of tubercle bacilli totally disintegrated in chloroform. From this I extracted by the use of distilled water an acid-fast fatty substance and a substance soluble in water. Both produced the cutaneous reaction in tuberculous subjects. The remainder of my chloroform solution is at the disposal of any biochemist who would care to make an analysis.

Excellent results have been obtained with all the standard brands of tuberculin. For the past ten years I have been using Koch's bacillary emulsion (a suspension in glycerine of bacilli ground to detrition) with the intention of immunising the patient against all the constituents of the bacillus. When the pure emulsion is injected the glycerine causes momentary pain, but this can be avoided by using a 5 c.c. syringe and a larger quantity of diluting fluid. If whole dead bacilli are injected a sterile abscess may form under the skin, but in my experience this has never occurred with Koch's B.E.

During the past decade American biochemists have isolated four fractions from the tubercle bacillus. These are:

1. A protein which gives the skin reaction in tuberculous subjects.
2. A phospholipin which is antigenetic.
3. A saturated fatty acid which stimulates the connective tissue cells to produce monocytes and eventually tubercles.
4. A polysaccharide which will kill a tuberculous animal in a few hours.

As all tuberculins contain this polysaccharide the ideal tuberculin might well consist of the first three fractions. The protein fraction has been used in America for diagnosis, but so far as I am aware William Stobie, of Oxford, is the only physician who has tried it in treatment, and his results are not yet published. From the protein, Florence Seibert has recently isolated Tuberculin P.P.D. (Purified Protein Derivative sold in the form of tablets). It is claimed that P.P.D. in the intradermal test is superior to Old Tuberculin, as the latter contains extraneous proteins. That is true, but I do not see why it should be better than T.A.F., in which the only extraneous substance is aspargin. The pity is that biochemistry should be so divorced from clinical medicine, and that the first three fractions of the tubercle bacillus have not yet been tried in treatment.

Dilution of Tuberculin.

The following method of dilution applies to all tuberculins:

Six Wright's bottles of 25 c.c. capacity are cleansed with chromic acid solution, well rinsed in running water, allowed to drain mouth downwards on filter paper, rinsed with distilled water, and sterilised together with their rubber caps, which are afterwards fixed by wire.

Eighteen c.c. of carbo-saline solution (0·8 gramme NaCl, 0·5 c.c. carbolic acid, and 99·5 c.c. distilled water) are run into each bottle from a 20 c.c. serum syringe, previously sterilised by washing out with ether. The bottles are labelled D_1, D_2, D_3, D_4, D_5, D_6. To the 18 c.c. of saline in bottle marked D_1 add 2 c.c. of pure tuberculin. This may be done with a 1 c.c. record syringe used twice. The mixture in bottle D_1 is well shaken, and is a

1 in 10 dilution. With the 1 c.c. syringe 2 c.c. of D_1 is carried to the carbo-saline in bottle marked D_2, and well mixed. Weaker solutions are prepared in a similar manner. The content of each bottle is easy to remember, as the small cipher represents the number of noughts in that dilution. Thus D_5 is a 1 in 100,000 dilution. This method of dilution enables the dose to be recorded as decimal fractions of a c.c. in the case of exotoxic tuberculins, or as decimal fractions of a milligramme in the case of the bacillary emulsions and P.P.D. The Koch bacillary emulsions contain in each c.c. 5 mg. of pulverised bacilli. Tuberculin Ruckstand (T.R.) contains 2 mg. of solid substance, the residuum of 10 mg. of bacilli which have been milled, mixed with water, and centrifuged. The supernatant fluid is thrown away. The solid residuum is again mixed with water and centrifuged to remove the heavier particles, until an opalescent fluid with fine suspended particles remains. With P.P.D., 0·04 mg. has the strength of 1 c.c. Old Tuberculin, so that 0·08 mg. dissolved in 2 c.c. of diluent would equal 2 c.c. of pure Old Tuberculin, Koch. In the following table I have shown the contents of each dilution in terms of c.c. for the exotoxic tuberculins, and in mg. for the newer tuberculins:

Exotoxic Tuberculins.	*Bacillary Emulsions.*	*T.R.*	*P.P.D.*
1 c.c. D_1=·1 c.c.	·05 mg.	·02 mg.	·004 mg.
1 c.c. D_2=·01 c.c.	·005 mg.	·004 mg.	·0004 mg.
1 c.c. D_3=·001 c.c.	·0005 mg.	·0004 mg.	·00004 mg.
1 c.c. D_4=·0001 c.c.	·00005 mg.	·00004 mg.	·000004 mg.
1 c.c. D_5=·00001 c.c.	·000005 mg.	·000004 mg.	·0000004 mg.
1 c.c. D_6=·000001 c.c.	·0000005 mg.	·0000004 mg.	·00000004 mg.

In practice it is simplest to write the dose in decimal fractions of 1 c.c. of undiluted tuberculin, or, when P.P.D. is available for treatment, in fractions of a solution of 0·04 mg. in 1 c.c. of diluent.

It should be noted that similar dilutions of different tuberculins are not clinically of the same strength. Thus P.T. is ten times stronger than P.T.O., and T.O. is ten times stronger than T.O.A. Again, T.O. is ten times stronger than P.T. Also T.R. is five times and B.E. ten times stronger than T.O. Lastly, P.P.D. is twenty-five times stronger than T.O. These are points to remember when changing treatment from a weaker to a stronger tuberculin.

The Initial Dose.

The ideal case for treatment is where the diagnosis of pulmonary tuberculosis has been confirmed by the subcutaneous tuberculin test. In that test I give the following doses of T.A.F.: 0·0001 c.c., 0·0002 c.c., 0·001 c.c., 0·005 c.c., and 0·01 c.c. A febrile reaction to doses of 0·001 c.c. and less is diagnostic of tubercle. A reaction to 0·005 c.c. is less diagnostic, and all

other facts in the case must be considered. A reaction to 0·01 c.c. is not diagnostic of tubercle, but a negative reaction excludes tubercle. If the patient has reacted to any of the first four doses, I begin treatment with a dose one hundred times smaller. Thus, if the patient reacted to 0·0001 c.c., the first dose for treatment would be 0·000001 c.c. In all cases where tubercle bacilli are present in the sputum, or where the diagnostic test has not been given, the initial dose should be 0·0000001 c.c. To return to the ideal case which reacted to 0·0001 c.c., we begin with an initial dose of 0·00001 c.c., which is 0·1 c.c. of D_1.

Technique of Injection.

In addition to the six dilutions, a 100 c.c. rubber-capped flask of carbo-saline is needed. Injections are made with a 1 c.c. record syringe graduated to $\frac{1}{50}$ or 0·02 c.c. Each of the ten large divisions corresponds to 0·1 c.c. Between these are five small divisions, each corresponding to 0·02 c.c. The syringe is sterilised by washing out with methylated ether, all trace of this being removed by filling and emptying the barrel several times with air. Steel needles kept in lysol do not rust, and the lysol is removed by plunging the needle several times into boiling water. The patient's weight, pulse-rate, and the dose of tuberculin to be given are entered on his chart, which also shows the daily temperature at 8 a.m., 4 p.m., and 8 p.m. The skin over the lower ribs below the scapula is cleansed with ether. Here the skin is least sensitive, and patients often do not feel the injection. The rubber cap of the bottles to be used is also wiped with ether. With B.E. the bottle is well shaken. The needle is thrust through the rubber cap and the dose withdrawn. The needle is then thrust into the diluting fluid and the contents of the syringe made up to 1 c.c. If air be first pumped by the syringe into the rubber-capped bottles, and if they are turned upside-down when the dose is to be withdrawn, the fluid is expelled into the syringe and none can be drawn back into the bottles. In the same way no tuberculin can contaminate the diluting fluid.

A fold of skin is picked up between thumb and forefinger, the needle is inserted with a stab, and the injection made subcutaneously. I use no dressing. If any blood appears, the injection has entered a vein and a much greater reaction to tuberculin may be expected than if the injection had been subcutaneous. To avoid intravenous injections, the plunger should be drawn up slightly as soon as the needle has pierced the skin. If the point of the needle be in a small vein, blood will appear in the syringe. After each injection, needle and syringe should be washed in boiled water to remove any trace of tuberculin. Ether would precipitate tuberculin left in the syringe.

(*a*) *How to Increase the Dose.*

The secrets of successful treatment are (*a*) how to increase the dose, (*b*) how to space the doses, and (*c*) how to deal with reactions.

My initial mistake in using tuberculin was to increase the dose on an arithmetical scale—*e.g.*, 0·1, 0·2, 0·3 c.c., and so on. It is obvious that this involved enormous and erratic jumps: an increase of 100 per cent. between 0·1 and 0·2 c.c., and an increase of 11·1 per cent. between 0·9 and 1 c.c. The increase must be geometrical, and the extent of that geometrical increase varies for individual patients, and for the same patient at different times in the course of treatment.

Once the initial dose has been given, I commence the increase by doubling it until a reaction occurs. In the case cited, 0·1 c.c. D_4 would be followed by 0·2, 0·4, 0·8 D_4, and then by 0·16, 0·32 c.c. D_3, and so on until a reaction occurred. Once a reaction occurred, the exciting dose would be repeated or reduced according to the degree of reaction until the patient gave no reaction. After that a lower rate of progression would be commenced, a half, quarter, fifth, or tenth part of the preceding dose being added for the next dose. To use the highest rate of geometrical progression without causing reactions is the aim of treatment. To immunise the patient to pure tuberculin is our ambition, and the only danger is lest we seek to reach the goal too swiftly. *Festina lente* should be ever present in the minds of those who use tuberculin.

(*b*) *How to Space the Doses.*

My next mistake was to give injections of tuberculin at regular intervals irrespective of the strength of tuberculin injected. A small dose of tuberculin is more rapidly absorbed than a large dose, and if the doses are not spaced according to the amount of tuberculin injected, violent reaction will occur. These I once attributed to anaphylaxis, but am now convinced these are due to summation of one dose on the top of another. For those who wish to use P.T. followed by T.O., the following table by Gillespie[2] will prove useful:

P.T. ·0000001 c.c. to P.T. ·00001 c.c. ..	Three or four days (*i.e.*, injections are given twice a week).
P.T. ·00001 c.c. to P.T. ·001 c.c.	One week.
P.T. ·001 c.c., or T. ·0001 c.c. to T. ·001 c.c.	Two weeks.
T. ·001 c.c. to T. ·01 c.c.	Three weeks.
T. ·01 c.c. to T. ·1 c.c.	Four weeks.
T. ·1 c.c. to T. ·2 c.c.	Six weeks.
Above T. ·2 c.c.	Eight weeks.

With B.E. I find the most useful rule is never to give an injection until the subcutaneous lump produced by the previous dose has entirely disappeared. I tell patients not to come back until the lump is no longer palpable, and patients say they feel at their best after the swelling has disappeared. The time the lump persists varies in different patients. To the same amount of tuberculin the local reaction in one patient may disappear within a week, and in another patient may persist for three weeks. For that reason I do not use a routine scale of spacing doses, but my observations confirm Gillespie's view that the larger the doses the longer should be the interval between injections. With pure B.E. the interval may be eight to twelve weeks. The maximum dose, the largest amount of tuberculin that can be tolerated without reaction, varies for each patient. If a patient be immunised to 2 c.c. B.E., a high degree of immunity has been obtained. Camac Wilkinson has reached doses of 4 c.c. B.E. In other patients I have found it impossible to go beyond 0·2 c.c. B.E. How long should treatment be continued? As long as the patient has any signs or symptoms of active disease, because even when complete arrest of the disease cannot be obtained tuberculin will hold the disease in check. When the disease has been completely arrested, the patient should return every year for a test injection to make sure that immunity has not fallen. It is clear that in some cases the injections may have to be spaced out over a considerable time. If that be regarded as a disadvantage, it should be noted that these are the cases where the injections are given at long intervals. One of Gillespie's patients had a large cavity in one lung. Treatment began nineteen years ago. She is still under treatment, but the treatment consists of one injection of 0·5 c.c. T.O. every two months. That is not a tedious treatment in comparison with insulin.

(*c*) *How to Deal with Febrile Reaction.*

In the first place it is necessary to distinguish between the different types of febrile reactions (Chart I.).

(1) There is *the immediate reaction with a fall by crisis.* Within twenty-four hours the temperature has risen and fallen to normal. In these cases, provided the temperature has not exceeded 102° F., the same dose is repeated until no reaction occurs. If the reaction exceeds 102° F., the dose should be reduced. On this point Camac Wilkinson, who has made most use of febrile reactions, writes:

" If the temperature be above 102° it may be wise to diminish the dose or to suspend the injections altogether for three or four weeks. After a fortnight's interval of time it is not wise to increase the dose, and it may

be best to diminish it. After a month's interval the dose must be reduced to one-quarter or one-fifth of the previous dose. Then it is often an easy matter to proceed to larger doses rapidly—at intervals of three or four days. However, these details depend upon circumstances, and we should always bear in mind Koch's original warning that there must be no routine method, since each case has to be treated on its own merits."[3]

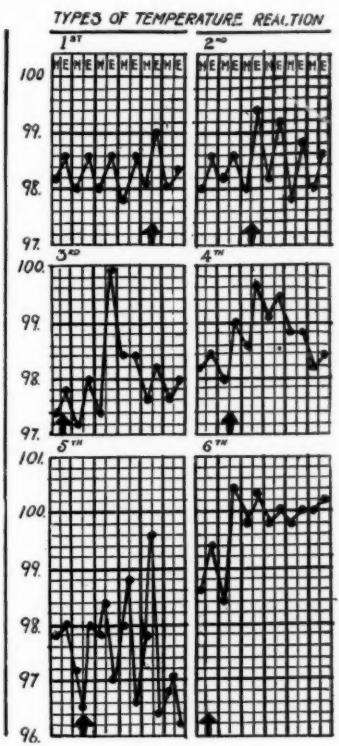

CHART I.

(2) There is *the immediate reaction with a fall by lysis.* The temperature rises within twenty-four hours, but does not reach normal until after forty-eight or seventy-two hours or longer. Here, if the temperature has not exceeded 102° F., the next dose should be halved, and if it has exceeded 102° F. the next dose should be one-tenth of the exciting dose.

(3) *A delayed reaction with a fall by crisis.* The temperature rises within forty-eight hours and falls by crisis. If the reaction does not exceed 102° F. the next dose should be one-fifth of the exciting dose, and if the reaction exceeds 102° F. the next dose should be one-tenth of the exciting dose.

(4) *With a delayed reaction and a fall by lysis* the next dose is one-tenth of the exciting dose.

(5) *A progressive reaction with a fall by crisis.* The temperature reaches the maximum within seventy-two hours and falls by crisis. That is a danger signal, as the rising oscillations are probably due to a focal reaction eventually overcome by immunising response. The dose should be reduced to one-hundredth of the exciting dose.

(6) *A progressive reaction with a fall by lysis* is the fever of tuberculous broncho-pneumonia. This should never occur if tuberculin is properly administered. The proper increase and spacing of doses and the right method of dealing with febrile reactions obviates any of these dangers. In the past, failure to distinguish the different types of febrile reactions led to denunciation of the reaction school by the non-reaction school. Both in their own way were right.

What Happens after an Injection.

After every injection of tuberculin there is a local reaction, and there may be a febrile, focal and general reaction. At least a score of theories have been advanced to explain these reactions. With these theories I am not now concerned. I shall merely refer to ascertained facts. After an injection of B.E. a lump appears in the subcutaneous tissues. If a large bore needle attached to a record syringe be inserted into the lump, and suction is applied, a small quantity of the interstitial fluid is drawn into the barrel of the needle. When this is expressed on to a slide and stained with methylene blue, it is found to consist of hundreds of polymorphonuclear leucocytes. It is strange that I should have made this simple observation for the first time during the past year. In the lump are thousands of leucocytes. What are they doing? It is known that unwashed tubercle bacilli repel leucocytes, whereas washed bacilli attract them. In the lump leucocytes are digesting particles of tubercle bacilli, and if the Law of Weber holds here, the leucocytes will produce more enzymes than are needed to digest the particles present. These extra enzymes will be later available for attacking living tubercle bacilli at the site of disease. For that reason I do not give another injection until the lump has disappeared, and so avoid reactions due to summation of dosage. Once the lump has gone the leucocytes are able to tackle a larger dose of tuberculin. Sir Almroth Wright showed that the opsonic index drops during the febrile reaction to tuberculin and rises when the fever disappears. H. Clarke and myself,[4] in 1907, found that a dose of tuberculin not sufficient to cause fever nevertheless altered the opsonic index (Chart II.). On the day of injection we each took the opsonic index at 9 a.m., when the injection was given, and again at 10 a.m., 11 a.m., 1 p.m., 2 p.m., 3 p.m., and 4 p.m. During these hours we found a pre-negative rise. The next three days showed the usual negative phase, followed by the rise. A small dose of tuberculin, 0·000001 c.c. T.R.,* had raised the opsonic index from 0·75 to 1·5. If the opsonic index be an index of immunity, then tuberculin is an immunising agent. Camac Wilkinson writes:

"That in all the cases in which I have had the opsonic index estimated I have found that by gradually increasing the dose of tuberculin at intervals of three to seven days, varying with the degree of reaction, the opsonic index, far from being depressed, is raised far above the normal."[5]

Results.

The results of treatment depend on the stage at which the disease is diagnosed and treated. By means of the subcutaneous tuberculin test it is

* In those days we recorded doses in mg. or fractions of a mg., on the assumption that there were 1,000 mg. in each c.c. of pure T.R. On the chart the dose is shown as $\frac{1}{1000}$ mg.

possible to make, in conjunction with X-rays, an earlier and more accurate diagnosis than by any other diagnostic method. When tubercle bacilli have appeared in the sputum the disease is advanced. As regards the area of lung involved, the results of treatment are naturally better in Stage 1 of the Turban-Gerhardt classification than in Stages 2 and 3. Nevertheless, even with extensive lesions the results of tuberculin treatment are better than can be attained by sanatorium treatment—*i.e.*, open air, suitable diet, rest and graduated exercise. The cost of tuberculin treatment is

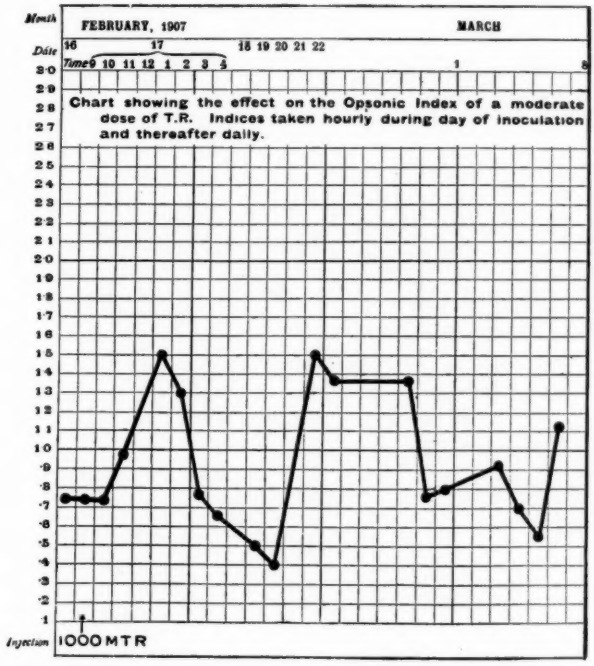

CHART II.

negligible as compared with sanatorium treatment, because the patient can be treated at home, and often without interference with his or her occupation. In comparing different methods of treatment it is essential that the cases treated should be not only in the same stage, but also in the same social class, so that as far as possible all the circumstances, bar the treatment given, are similar.

In County Down, Gillespie was able to make an accurate comparison of these two methods of treatment, and his results deserve a much wider

publicity than they have as yet received.* Every year in County Down the Tuberculosis Officer and his colleagues try to trace all the survivors of those diagnosed as pulmonary tuberculosis at the dispensaries. They succeed in tracing almost all of them, and note whether each one is or is not fit to work.

In 1932 Gillespie[6] found the number of patients who were at work up to ten years after a diagnosis of pulmonary tuberculosis had been made. In each case the diagnosis had been made prior to 1923. In the cases compared all had tubercle bacilli in the sputum when diagnosed. Some were in Stages 1 and 2, others in Stage 3 of the Turban-Gerhardt classification. The results of treatment are therefore strictly comparable. Some of these patients were treated with tuberculin for at least three months at home, and never went to a sanatorium; others were treated in a sanatorium for not less than three months, and never had tuberculin; and some received either less than three months' tuberculin or sanatorium treatments. These last cases are classed as "treated otherwise." From this comparison all cases who had both tuberculin and sanatorium treatment were excluded. The two sanatoriums to which the patients were sent stipulated that the cases must be early, or have some prospect of returning to work. Patients who showed no signs of improvement were usually discharged with less than three months' treatment. All such cases were excluded from the comparison, except in so far as they came under the heading "Treated Otherwise."

In Stages 1 and 2 the percentage of patients at work up to ten years after diagnosis was as follows:

Treatment.	*Years after Diagnosis.*								
	2.	3.	4.	5.	6.	7.	8.	9.	10.
Tuberculin	58·3	51·4	47·2	48·6	44·4	43·1	37·5	36·1	33·3
Sanatorium	15·7	19·6	17·6	16·2	15·7	13·7	13·7	13·7	11·8
Otherwise	19·1	12·8	12·8	11·7	10·6	9·6	8·5	7·4	8·5

In Stage 3 the percentage of patients at work was as follows:

Treatment.	*Years after Diagnosis.*								
	2.	3.	4.	5.	6.	7.	8.	9.	10.
Tuberculin	35·4	19·0	17·7	15·2	12·7	10·1	10·1	10·1	7·6
Sanatorium	16·25	10·0	6·25	6·25	6·25	5·0	6·25	6·25	3·75
Otherwise	9·9	8·1	6·4	7·0	4·6	5·8	4·6	3·4	3·4

* "The Use of Tuberculin in the Diagnosis and Treatment of Tuberculosis," *Ulster Medical Journal*, October, 1932.

In this article I have sought to avoid controversy and to state what I believe to be facts, in the hope that others may become interested in the study of tuberculin, because there is still much to be learnt about this, our greatest asset for the diagnosis and treatment of tuberculosis.

REFERENCES

1. Quoted by WILLIAM STOBIE, F.R.C.P., in *The Tubercle*, June, 1931, p. 2.
2. JOHN R. GILLESPIE, M.A., M.D., D.P.H., in *The Ulster Medical Journal*, October, 1932.
3. W. CAMAC WILKINSON, B.A. (Syd.), M.D. (Lond.), F.R.C.P.: Tuberculin in the Diagnosis and Treatment of Tuberculosis, London, 1912, p. 224.
4. CLARKE AND SUTHERLAND: *The Lancet*, July, 1907.
5. W. CAMAC WILKINSON: *Loc. cit.*, p. 245.
6. J. R. GILLESPIE: *Loc. cit.*, p. 5.

TUBERCULIN IN IRIDOCYCLITIS AND SCLERITIS

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TUBERCULIN, in the treatment of eye disease, in my experience is chiefly of value in cyclitis and keratitis. These conditions have physical signs which can readily be demonstrated, but may arise from many different etiological factors. Sometimes the cause is easily discoverable as due, for example, to oral or nasal sepsis or syphilis, while, again, every examination may prove repeatedly negative. One eye is usually first affected, but, when treatment is unsuccessful and the second eye becomes attacked, continued failure to find the cause of the disease distresses both patient and surgeon. Sepsis and syphilis being well-recognised causes, a test for tuberculosis, the *third* member of this famous triad, would seem logical, and if in the presence of previous failure a positive diagnostic reaction were followed by successful treatment by tuberculin, cure of the condition would make it evident that in fairness both to the patient and his surgeon this line of attack could be ignored no longer.

In iridocyclitis the anterior parts of the uveal tract within the eye become inflamed. The clinical appearance of such a case is shown in Figs. 1 and 2. The iris, its vessels dilated, is seen to be rendered immobile by adhesions to the underlying lens, while upon the posterior surface of the lower quadrant of the cornea are the deposits of " k.p." (keratitis punctata), which are diagnostic of this condition. A gelatinous exudate, thrown out by the inflamed ciliary body, lies at the bottom of the anterior chamber, blocking the drainage from it and giving rise to secondary glaucoma. Inflammation of the ciliary body also leads to effusion into the vitreous and the development of a thick cloud of fine, floating vitreous opacities which obscures the view of the fundus and lowers visual acuity. This is often followed by secondary cataract due to failure of nutrition in the lens. All these occurred in the case from which the drawings were taken while it was under observation. The second drawing also shows the " k.p." on the back of the cornea and the exudate in the anterior chamber illuminated by the beam of the slit-

lamp. Every attempt made to arrive at the cause of the condition failed: teeth, nose and throat, and genito-urinary system were examined; Wassermann and complement fixation tests were done, all with negative results. When the second eye became affected an intracutaneous tuberculin test, carried out by Dr. Camac Wilkinson, gave a positive result, and treatment was followed by steady improvement. This was my first case of iridocyclitis efficiently treated in a very late stage of the disease by tuberculin in 1927; and, although sight in the original eye was not regained, the second eye has settled down and still retains useful vision.

Since that time many similar cases have been under my care in which the cause was to seek until the intracutaneous tuberculin test proved positive. In one case there was well-marked iridocyclitis in each eye when examined with the slit-lamp. The patient had no pain or discomfort while she re-

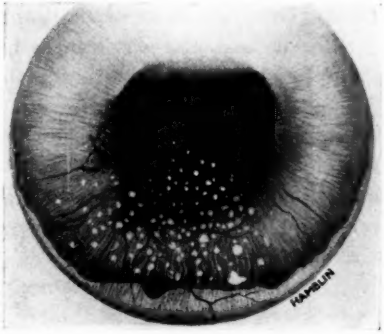


FIG. 1.

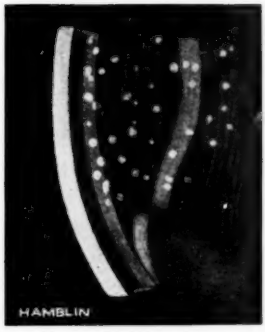


FIG. 2.

frained from using her eyes, but had severe occipital headache immediately if she attempted to read or sew. Her statement was: " If I use my eyes I am no good the next day." She recovered perfectly on tuberculin combined with local treatment. It may be that in this case the headache was due to a post-nasal meningitis. It was characteristic of all the cases that pain was very slight and ciliary infection minimal, but sight was seriously affected by increasing vitreous opacity. It was in some cases very difficult to see the " k.p." except with the slit-lamp.

The nature of the damage done to the affected eye by the attack of iridocyclitis varied, but there seemed to be a special tendency to failure of lens nutrition and the formation of secondary cataract. A rather unexpected feature was the liability to relapse after a holiday spent at the seaside. Whether this was due to increased exercise or exposure to the sun it was difficult to determine, but it was of interest that while treatment by actino-

therapy or diathermy made these patients worse, *rest in bed* for five weeks as an in-patient provided a successful result in a case that had been unsuccessfully treated with tuberculin while she continued to make a considerable journey to the hospital on the occasion of each out-patient visit.

Another clinical manifestation which was negative to all other diagnostic tests and failed to respond to ordinary local treatment, but was successfully treated with tuberculin, might be described as a discrete interstitial keratitis.

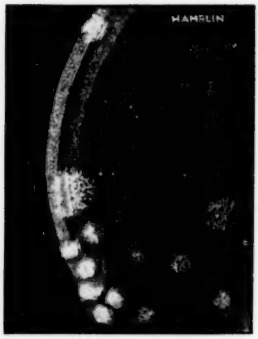


FIG. 3.

The drawing (Fig. 3), made from the first case which I saw of the kind, illuminated by the beam of the slit-lamp, shows very well the corneal condition present. It will be observed that while the areas of infiltration are intra-corneal they are accompanied by patches of deposit upon the post-surface, indicating that the ciliary body is also inflamed and Descemet's membrane damaged. In each case the second eye was attacked, but, unlike the simple iridocyclitis, the patients complained of much pain and photophobia, which was reduced only when tuberculin was combined with efficient local treatment. At the end of four months the corneal scarring became almost negligible, and recovery has been permanent.

In a third clinical manifestation of this condition, also negative to all tests, the discrete interstitial spots were confluent and formed an intra-corneal disc of opacity. The slit-lamp showed the cornea in the region of the disc to be considerably swollen. On the posterior surface of the cornea, behind the disc, were the characteristic spots of "k.p." already described.

Sympathetic ophthalmia is one of the terrible complications of ocular injury, whether accidental or surgical. Briefly, it is a plastic iridocyclitis of the opposite *sound* eye occurring usually from three to ten days, but sometimes many months, after a perforating ocular wound in the danger area within a millimetre of the corneal margin or limbus. Wounds in this region involve the ciliary body, and it is this which appears to be dangerous. The attack of inflammation in the sympathising eye is preceded by irritation in which there is increasing photophobia and lacrimation, but even at this stage examination with the slit-lamp will reveal "k.p." already present upon the cornea. All eyes so badly injured as not to be likely to regain useful vision should therefore be removed forthwith, and removal of an injured eye on the first sign of irritation in the sound one will probably prevent its sympathising, but if iridocyclitis has once started in the second

eye, removal of the injured one will do very little good, and it may even be the better eye of the two in the end.

The etiology of this condition (apart from injury) is very obscure, but three facts are known:

(1) A blood count will reveal a large-celled lymphocytosis.
(2) Microscopical examination of the injured eye reveals patches of small-celled infiltration in the choroid and ciliary body (but never any giant cells).
(3) Injections of salvarsan sometimes succeed in quieting the condition (although it is, of course, in no way associated with syphilis).

In view of these facts, I now have every case of sympathetic ophthalmia under my care (it is fortunately not a common condition) tested by the intracutaneous tuberculin test at the earliest possible stage, and, if positive, treated with a full course of tuberculin. In two cases the result has been perfectly successful: in both the eyes have been saved, in neither has the injured eye been removed. Whether future experience will confirm this happy result I cannot say, but that the tubercle bacillus alive in the body, having been made aware of its opportunity by some kind of chemotaxis arising in the tissues, should attack the ciliary body when it is injured seems to correspond to what we know of the habits of the organism elsewhere.

Scleritis is another relatively uncommon ocular condition, sometimes associated with iridocyclitis, in which the cause is often quite obscure. The local inflammatory patch may be superficially or deeply placed in the sclera with well-marked swelling in the former and severe pain in the latter case. The disease tends to relapse, the recurrent attacks leading to thinning of the sclera, so that the blue choroid comes to show through, and finally resulting in staphylomatous bulging of the ocular wall. The discovery of the cause of the attacks is often difficult. Three of my cases, in which routine examination of the ordinary character failed to reveal it, were positive to the intracutaneous tuberculin test and recovered without difficulty on a course of tuberculin. Relapses did occur in these cases, but were cut short by a further course of injections. In one case of fifteen years' standing " routine " dosing with tuberculin had been without effect. The proper technique of the individual " dosage curve " was clearly essential in this case as in many others.

The relationship of ocular to more generalised tuberculosis is of interest, and seems to me as follows:

The proportion of the population attacked by the bacillus I believe to be high. The great majority of these recover perfectly, having acquired immunity from their primary focus, and the bacillus no longer lives in their bodies. A certain number do not acquire immunity and, unless removed

from their natural surroundings and made to live in the artificial conditions of a sanatorium, they eventually succumb, perhaps to secondary infection. There still remains a large group where efficient immunity is never acquired, where the bacillus still remains alive in the body ready to respond to favourable conditions. It is to this intermediate group, who often suffer from chronic ill-health of an obscure character, that I believe cases of ocular tuberculosis belong, and in which tuberculin may still be found to be of the greatest service in treatment. In ocular tuberculosis the physical signs are unmistakable in the earliest stage. Long before the stethoscope or even X-rays could detect any comparable lesion in the lung, the slit-lamp will reveal the presence of " k.p." upon cornea, and tuberculin will yield a positive intracutaneous test.

After watching the progress of eye cases treated with tuberculin, reasons suggest themselves why this line of treatment has appeared on occasion to be either useless or harmful. Tuberculin, at first without effect when given without *rest*—an essential in the treatment of all tuberculous lesions—was, when combined with in-patient treatment, successful. Clinical experience with eye cases, however, at least leaves one in doubt if *sunlight* does not actually do harm in certain stages of the disease: iridocyclitis repeatedly relapsed, showing more " k.p." and increased vitreous effusion after a holiday spent at the seaside. Further, it must be appreciated that once the diagnosis is established, treatment with tuberculin must be carried out consistently over a period of at least a year before it can be said to have failed to produce results.

The technique of tuberculin treatment is also at the root of its success or failure. Each case should be treated on its merits, the proper initial dose judged from the reaction to the intracutaneous diagnostic test, and each subsequent dose ordered having regard to all that has gone before, and not by " rule of thumb." The best type of tuberculin to use in the various stages of immunisation should also be considered. Each case has its own particular " dosage curve," some showing the straight line of a steadily increasing dose, others a very slow, early immunisation with rapidly developing tolerance in the later stages for the larger doses, and a few rapid initial rises in the early dose with more slowly advancing increases later. There are three factors to be studied: the local reaction at site of infection; the general reaction, indicated by the rise of temperature and accompanying malaise; and the focal reaction in the lesion one is endeavouring to treat. The latter is of extreme importance in eye disease. There must be enough reaction to convince one that something is being achieved, but it must never reach the point of risking such a complication as secondary glaucoma. When a statement was made that tuberculin had already been tried, it

was found on enquiry either that routine dosage at regular intervals had been given, perhaps without any *rest* or very much interest in the three factors mentioned above, or that the doses had been continued for a few weeks and then abandoned either because the patients had been made so ill that they refused to continue or because no effect at all had been produced. One would suggest that in both cases technique had left something to be desired, nor can one ignore the very different effect upon different patients of the malaise which follows the injection of tuberculin.

It has appeared to me that the giving of tuberculin should be in the hands of those so thoroughly versed in its clinical manifestations, as well as in those of tuberculosis, as to be neither fearful nor foolhardy in its use, and with sufficient time at their disposal to study the reactions and (treating each case on its merits) to supervise the " dosage curves."

All my cases of ocular tuberculosis are treated with tuberculin by Dr. Camac Wilkinson, privately and in his clinic, while I remain carefully observant of the clinical side of the picture, and to his perfect collaboration I attribute the very large measure of success we have been able, fortunately, to obtain.

The cases upon which this paper is based are necessarily too few in number, but they are a plea for the intracutaneous diagnostic test to be regarded with the same " open mind " as the Wassermann reaction. I feel sure that if this were done useful knowledge would be gained of tuberculin, which, if used with the proper technique, would once more take its rightful place amongst our methods of treatment.

CONSULTATION

CASE 1

By R. A. YOUNG,
C.B.E., M.D., F.R.C.P.

In October, 1930, a girl of eighteen developed a febrile attack, which was thought to be influenza. After ten days the temperature settled, but she was left with a cough and pain in the right side of the chest. On examination a pleural rub was heard. Cough persisted, and examination of the sputum disclosed the presence of tubercle bacilli. She was sent back to bed, and the temperature was found to be 100-101° in the evening, and 98° in the morning.

On examination of the chest, a few crepitations were heard below the clavicle, in the second and third intercostal spaces, on the right side. X-ray showed an area of infiltration in this region.

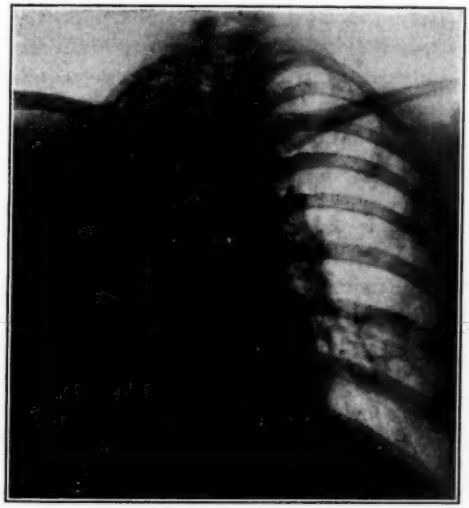
She was kept in bed at home for a month, but the temperature and physical signs persisted, and X-ray showed a considerable increase in the shadow. Artificial pneumothorax was therefore started at the end of December, 1930. The lung collapsed well, the temperature fell, the condition of the patient improved steadily, and in February she went to Switzerland, where she remained at a sanatorium until April, 1932.

On her return the right lung was well collapsed and there was a small effusion in the pleural cavity; it was thin but slightly cloudy, yellowish liquid, and contained tubercle bacilli. No physical signs were found in the other lung. Her general condition was good, and she had gained 18 lbs. in weight, was apyrexial, and had no cough or other symptoms. She lived a quiet life at home, having regular rest-hours before lunch and dinner, and for two hours after lunch. She took regular walks of about four miles each morning, but beyond this no other exercise.

In January, 1933, she started another febrile attack, and was in bed for three weeks. This was thought to be due to pleurisy. The effusion had now become thick and greenish, but contained no organisms other than

tubercle bacilli. It was aspirated and replaced with oxygen. An X-ray taken in April showed, for the first time, some infiltration in the middle zone of the left lung. In view of this, and the fact that the effusion in the right pleural cavity was now tuberculous pus, it was decided to aspirate repeatedly and replace the effusion with oxygen in order to encourage re-expansion of the right lung. She was also put to bed and given a course of sanocrysin to check the spread of disease in the left lung.

After six months of this treatment, the heart and trachea were displaced to the right, the right lung showed signs of some re-expansion, but the effusion was still present and re-formed quickly after each aspiration. On the left side there were now several cavities in the lower as well as the middle and upper zones. There was no cough or sputum, however, and the patient felt well in herself. The skiagram shows the X-ray findings at that time.



In view of these findings, a consultation was advised in order to discuss the best treatment of the tuberculous empyema, whether sanocrysin should be given or an attempt made to collapse the left lung, how much she should be allowed to do, where she should spend the winter, and the probable course and ultimate prognosis.

The problems offered by this patient, both as regards treatment and prognosis, are among the most difficult to be met with in this highly variable and complex disease. Here is a young girl, eighteen years of age, developing acute signs at the right apex. Diagnosis is fortunately established without any delay. Treatment at home by rest fails, and it is apparent that the disease is active and spreading rapidly.

The decision to start artificial pneumothorax treatment before any definite spread to the opposite lung occurs was sound and in accordance with modern practice. The immediate result is satisfactory, and 14 months' sanatorium treatment in Switzerland appears to have established encouraging quiescence but not complete arrest. With absence of fever, a gain of 18 pounds in weight and a moderate capacity for exercise, the outlook would seem to be

very favourable, save for the evidence of pleural involvement afforded by the persistent small effusion with tubercle bacilli present in it. Such a condition is consistent with eventual complete recovery, since it may lead to gradual obliteration of the pleural cavity with spontaneous absorption of the fluid and re-expansion of the lung.

Unfortunately, after about 9 months, fresh activity occurs, the fluid in the right pleura becomes definite tuberculous pus and there is now a tuberculous pyopneumothorax, which eventually becomes a tuberculous empyema. If no further developments had occurred, the problem of treatment would have involved a comparatively simple decision—viz., to determine whether to watch the patient's general condition and remove fluid from time to time if any distress occurred, in the hope that the pleural involvement would slowly subside and the lung gradually expand, or to replace the fluid from time to time with air or oxygen—watching the lung condition by X-ray after each withdrawal; and then, if progress were slow and if the patient's general condition seemed favourable, to consider thoracoplastic treatment.

In the case under consideration this course proves impracticable, since, within three or four months, it becomes clear that the set-back in January, 1933, was associated with the development of active softening lesions in the left or contra-lateral lung. Active surgical measures were therefore out of the question, and the course adopted of repeated aspirations and oxygen replacement to encourage expansion of the right lung was well-advised and in accordance with the most usual practice. The use of sanocrysin to try to control the lesions in the other side is in pursuance of one of the most generally accepted indications for that treatment. In spite of some evidence of improvement, notably the falling-in of the ribs on the right side, the displacement of the trachea, heart and mediastinum to the right, and some commencing re-expansion of the collapsed right lung, the rapid reaccumulation of the fluid and the need for repeated aspiration, together with the development of widespread excavation on the left side, make the position at the time of the consultation an anxious one.

We may first consider what treatment to adopt for the right side. It is obviously important to encourage the re-expansion of that lung—since any increase in its function should be an aid and protection to the left side, while the longer it remains unexpanded the thicker the visceral pleura is likely to become and the less chance there is of the eventual complete re-expansion of that lung. Four possible courses may be considered: (1) to leave it alone; (2) repeated aspirations, with gas or oxygen replacements ; (3) repeated aspirations and washing out the pleura with some antiseptic ; (4) thoracoplasty.

The first course, that of leaving the right side alone, is undesirable in this case, since, with the tendency to rapid reaccumulation of the fluid, the

probability is that re-expansion would be hindered and even that further compression of that lung might occur.

Thoracoplasty in the present condition of this patient would involve too great risks, owing to the activity of the pleural disease and the state of the left lung.

The choice lies, therefore, between repeated aspiration with oxygen replacement, the course hitherto adopted in this case, or aspiration and gas replacement with occasional wash-outs with some antiseptic, such as Dakin's solution or methylene blue. Of these the former is to be preferred in this case. It should, however, be remembered that even this procedure involves the risk of infection of the needle track with subsequent sinus formation.

The treatment of the left side may now be considered, and the decision to be made is a very important one—notably as to whether any active interference, such as a very cautious selective collapse by artificial pneumothorax, should be attempted, or whether to be content with climatic, hygienic, general and symptomatic treatment. In this case it would seem that the latter course might be followed at any rate for a time, in view of the good general condition of the patient, the absence of fever and of cough and sputum. For this purpose a stay in a sanatorium, either in this country or in Switzerland, should be recommended, since regular observation and X-ray control are essential. A further course of Sanocrysin, cautiously given, with special watch for toxic symptoms, would be worth trying. If it became clear at any time during this treatment that the disease were spreading in the left lung, or if the sedimentation rate of the red corpuscles showed a marked increase, very cautious selective collapse might be attempted, but before this it would be wise to estimate the vital capacity, since if this were conspicuously reduced it might contra-indicate the operation or suggest the introduction of very small amounts of air, at any rate at first.

The prognosis in such a case is difficult to estimate, but is often better than might at first be expected. The earlier course of this case suggests some considerable degree of resistance, and there was an effective, though incomplete, response to treatment: even after the set-back of January, 1933, with its widespread and almost disastrous effects, this patient shows signs of stabilization, since the right lung tends to expand slowly, while the left-sided lesions though widespread and proceeding to cavitation do not appear to be of rapidly spreading or infiltrating type. If the disease on this side becomes arrested, there is a reasonable hope that the right side may eventually re-expand and that the general condition of the patient may then permit of some form of thoracoplasty if necessary, but at best the duration of treatment is likely to be very prolonged, and there is always the possibility of active extension of the disease on the left side, leading to rapid decline and death.

CLINICAL CASE

DEATH FOLLOWING AN ARTIFICIAL PNEUMOTHORAX REFILL

By L. S. T. BURRELL,
M.D., F.R.C.P.

The patient, a woman of thirty-six, had a selective pneumothorax in the upper third of the right pleural cavity. This had been induced some four years previously and was kept up by small refills at long intervals. Her general condition was good, she was free from symptoms, and it was proposed shortly to abandon the treatment as she was regarded as cured.

On screening, the small localised pneumothorax cavity was seen and a refill was then given, the initial pressure of $-7-3$ being raised to $-2+1$ after 400 c.c. of air had been introduced. X-ray examination after the refill showed that the pneumothorax cavity was slightly larger. She had no pain during the refill, and that evening she went out to dinner and to a theatre. At about ten o'clock she developed a pain in the right side and felt ill, so returned to her hotel. During the night she began to vomit, and this increased the pain in the side. Vomiting continued and was the chief symptom for about eight hours. She then had less pain and the vomiting decreased, but she became more and more collapsed.

On examination no fresh physical signs were discovered. A needle was put into the pneumothorax cavity, as it was thought that she might have had a spontaneous pneumothorax into the artificial one, but the pressure was found to be negative and there was no free blood. Later in the day she complained of dimness of vision varying in intensity, and said that people in the room looked blurred. She also had some tingling in the extremities. There was no hemiplegia or physical signs on examination of the nervous system and the retinæ were normal. During the next night she steadily became worse, breathing became sighing, and she died forty hours after the refill.

At the necropsy it was found that some adhesions had torn below the pneumothorax cavity and there was about a pint of blood between the separated layers of the pleura. This might have accounted for the pain, but not for the vomiting which was such a prominent and early symptom, nor for the dimness of vision. The amount of bleeding was not sufficient to produce any serious symptoms, and could not have been the cause of death.

It seems most likely that an adhesion became torn and that some blood separated an area of adherent pleura, causing a small tear in the lung through which air entered the circulation, so that death was due to gas embolism.

MEETINGS OF SOCIETIES

THE TUBERCULOSIS ASSOCIATION

THE first meeting of the season was held on Friday, 23rd November, 1934, at Manson House. The Presidential address was given by Dr. L. S. T. Burrell, who took as his subject " Reinfection in Tuberculosis."

He said he had chosen this subject for his address because he thought that they ought at least to be able to agree as to whether or not tuberculosis was infectious. He deprecated the view taken by some authorities that the ordinary so-called adult type of pulmonary tuberculosis was a late manifestation of a previous infection, and that therefore a tuberculin reactor need take no special precautions in regard to contact with " open " cases of tuberculosis. Dr. Burrell suggested that all forms of tuberculosis after the incubation were fundamentally the same. The result of a primary infection —*i.e.*, the action of the bacilli on the body not rendered allergic or sensitive by previous infections—was to produce sensitivity or a state of allergy, and this initial latent period was the primary or incubation stage of tuberculosis. The symptoms of illness were secondary, whether they followed directly after the infection or whether there was a period of months or years before they showed themselves. Apart from the first few days—a negligible period in such a long disease—tuberculosis should not be regarded as primary. If the infection was a very large one, the disease might progress without interruption from infection to death. The incubation period was regarded by some as a primary type of tuberculosis, differing fundamentally from the second type; and yet microscopically, save for the absence of fibrosis, for the development of which there would of course have been no time, there was no essential difference between the two types. A very small initial infection would produce no signs or symptoms, and could only be recognised by a positive tuberculin reaction. A large infection might overwhelm the body, causing a general and fatal tuberculosis, and between these two extremes there were many other grades. Among the reasons for the difference in the reaction of individuals to tuberculous infection was the question of dosage, another being the possession of natural immunity. Natural immunity was strong enough to overcome an ordinary dosage of infection, so that in the overwhelming majority of cases an initial infection

could be overcome without clinical disease or even any signs of ill-health. Acquired immunity was incomplete and varied in different individuals, and also in the same individual from time to time. The allergic state simply tended to fix the bacilli, at least temporarily, and check their rate of spread, and thus tended to make tuberculosis a local disease.

In any case, a few days after an infection the body developed an acquired resistance, by which the course of the disease was modified. Whether the disease was caused chiefly or wholly by the growth of the bacilli originally introduced or by the growth of other bacilli subsequently introduced as a reinfection could make no fundamental difference. The body could not be so altered by allergy that while still susceptible to the tubercle bacilli it already contained it was immune to other tubercle bacilli that might reach it from outside. Repeated small infections were either overcome by the combined efforts of natural and acquired resistance or they might lead to the so-called chronic fibroid type. An overwhelming infection, endogenous or exogenous, led to acute tuberculosis, the fatal dose having a definite relation to the weight of the individual. Dr. Burrell concluded that a patient who expectorated sputum containing tubercle bacilli was a danger to others, although if reasonable precautions were taken this danger might be negligible. There was no direct or indirect evidence that the decline in tuberculosis had been influenced by acquired immunity; their efforts should, in his opinion, be directed towards preventing massive infection and protecting natural immunity by maintaining a good standard of living rather than by attempting to confer artificial immunity by vaccination.

After the reading of this paper, Dr. Toussaint showed a number of slides illustrating the familial incidence of tuberculosis, and the fate of children born in tuberculous and in non-tuberculous households.

At the evening meeting Dr. G. T. Hebert read a paper on " The Termination of Artificial Pneumothorax Treatment." He said that it was admitted that this treatment exposed the patient to certain risks, and that the shorter the treatment the better would be the restoration of function in the treated lung, and so there was justification for considering how soon the pneumothorax could safely be terminated. He suggested that in the past they had erred on the side of caution, and probably many of their cases might safely have been terminated much sooner than had actually been the case. In considering what should be their criteria in coming to a decision on this question, Dr. Hebert pointed out that in about 50 per cent. of cases the termination was not optional. Forced or unavoidable termination was mainly due to obliteration, usually following an effusion, or to spread of disease in the better lung, or to pleuro-pulmonary fistula. In an analysis of 210 cases

from the artificial pneumothorax clinic at St. Thomas's Hospital, the tabulated reasons for terminating the treatment in the "unavoidable" group were: Obliteration, 21 per cent.; contralateral disease, 19 per cent.; pleuropulmonary fistula, 3 per cent.; personal reasons, 8 per cent. In the "optional" group the treatment was given up in 10 per cent. of cases because the object was not attained, and in 39 per cent. because the object was attained. In the "object attained" group they had to consider how long to continue a treatment which was proving a success, and the speaker here emphasised the necessity for considering each case on its own merits, since each might differ from the others in so many ways, such as in the extent, type and activity of the lesion, and in the resistance, personality and financial circumstances of the patient. In deciding to collapse a tuberculous lung, they should always have one or more definite objects in view. The five results of collapse were: (1) Reduction of tension, thus favouring the formation of fibrous tissue; (2) the reduction of blood and lymph flow, thus decreasing toxæmia and, at a later stage, stimulating the formation of antibodies; (3) a check on the spread of disease by the bronchi; (4) reduction or obliteration of cavities when the walls were not too fibrous; (5) the checking of recurrent or of urgent hæmoptysis. During the course of treatment they should satisfy themselves that one or more of these desired effects were being produced. Thus, if the formation of fibrous tissue were the object aimed at, they could feel satisfied if the patient seemed to be doing well and X-ray examination showed complete collapse of the affected lung or selective collapse of the affected area. If only partial collapse was obtainable, the affected area might show a progressive decrease of density, which would be a definite indication that healing was taking place. In any case, when the desired effect, whatever it was, had been obtained, a certain period must be allowed for healing. The average duration of this period was two years or less. It would be shorter than the average if the desired effect was obtained rapidly, also if the lesions were small, even though numerous. It would be longer than usual in the converse of these conditions, also if cavities were present. In certain cases of bilateral disease with toxæmia the treatment might be discontinued within a year, and in cases of urgent hæmoptysis in a few weeks, on the assumption that the sooner the pleura returned to its normal state the less would be the chance of adhesions which might prevent a repetition of the treatment in a subsequent emergency of the same kind. The blood sedimentation test was a useful factor in assessing the progress of healing. It should preferably have been normal for at least six months before treatment was terminated.

With regard to the method of termination, gradual re-expansion was the

best, although the speaker had in several cases merely discontinued refills without any untoward results. In a small percentage of cases phrenic evulsion was necessary, particularly in severe cases with much fibrosis, and in cases with fibrous pleura. A discussion followed, in which several members took part. Dr. Vere Pearson referred to the question of " tension " of the lung in relation to the induction and termination of A.P. treatment. He also said that probably Dr. Hebert was quite right in regard to the speed with which he wished to bring about his object; his own tendency, and probably that of others, was to carry on in the hope that the treatment would do good presently. Dr. Davidson asked for more information as to the use of the blood sedimentation test, especially as regarded the combined index that had been worked out, in connection with the termination of A.P. Dr. Watt said that in many cases in which the object was not attained he himself would probably have terminated the collapse, but that since sanatorium patients would be passed on in most cases to the tuberculosis officer, he left the decision to him. He thought, however, that probably most physicians were unduly reluctant to terminate ineffective cases. In contralateral disease it was often a mistake to terminate the treatment; more harm was probably done by allowing the lung to expand. Not enough stress was laid, in his opinion, by Dr. Hebert on phrenic evulsion as a preliminary to terminating A.P. Dr. Young agreed that the termination of successful A.P. was always a matter of some anxiety, especially in the case of cavities held out by adhesions. Here there was a danger of pleuro-pulmonary fistula, and in such cases he thought A.P. should be terminated at once. Dr. Marshall asked whether it was ever good practice to go on after three years were up. Symptoms might recur even after three years. He thought perhaps they sometimes hung on with treatment that was not quite effective when they might be doing something else that would give better results. Dr. Heaf referred to the blood work done at Colindale which they had found of extreme value in deciding when they could safely terminate treatment. The serial blood count gave a definite indication of the patient's prognosis. If the intervals between insufflations were being increased and the blood picture was becoming worse, obviously the A.P. must be continued. Professor Lyle Cummins endorsed this view, adding that the blood picture was an indication of the degree of toxæmia present. Dr. Burrell said that his own feeling was that if at the end of three years, or even two years, the patient was not doing well, it was better to terminate the treatment and employ other measures.

Dr. Hebert in a brief reply said that A.P. was said to act as a splint to the lung; he preferred to say that it reduced the tension on the lung. Failure to obtain an effect within a reasonable time should definitely lead

to cessation of the treatment. He was not inclined to rely on laboratory criteria for terminating A.P., preferring to depend for this on clinical observation.

THE JOINT TUBERCULOSIS COUNCIL

A MEETING of the Joint Tuberculosis Council was held in London on November 24, the Chairman, Dr. Lissant Cox, being in the Chair. Dr. Trail stated that the investigations which the Council were making into the late results of artificial pneumothorax treatment included over 4,000 cases and it was hoped to issue a report in six months.

A preliminary report on the examination of contacts was discussed at length. The practical difficulties of these examinations are obvious. In the first place modern radiography has revealed many cases of undoubted pulmonary tuberculosis that could not have been detected by any other means, so that no examination can be regarded as complete without radiography. Yet it may be that a negative Mantoux test should be taken as excluding tuberculosis. Apart from the expense of radiography on a large scale, it is impossible to get all contacts to attend for examination. If they are ill or have a cough or some other definite symptom, they will usually come or be brought to the dispensary, but one of the great objects of contact examination is to detect disease and start treatment before the disease has become sufficiently advanced to produce symptoms. Another object is to detect the carrier or the one who has infected other members of the family. The Council hope shortly to present its report on this subject.

The report of the Milk Committee was then considered, and the Council reaffirmed its resolution passed in April to the effect that all milk from non-tuberculin tested cows should be boiled or pasteurised.

Dr. Brand stated that the courses of post-graduate study which were held during the year had proved so successful that it was hoped to arrange three more during 1935, one of them to be in Denmark. Particulars of these classes may be obtained from the Honorary Secretary to the Joint Tuberculosis Council, Dr. Ernest Ward, 123, Torquay Road, Paignton.

ABSTRACTS

Allergy as a Factor for Consideration in the Treatment of Tuberculosis. By S. L. CUMMINS. *Tubercle*, 1934, **15**, 433.

The relation of allergy to immunity must be determined before the problem of allergy in regard to treatment in tuberculosis can be profitably attacked. Pirquet, the coiner of the term allergy, pointed out that the immune person did not become "insensible to inoculation; but the time, quality and quantity of his reaction is changed." The altered reaction according to the time factor might be (*a*) early, (*b*) torpid early, (*c*) accelerated. The altered reactivity according to quality and quantity might be shown as: (*a*) Reinforced reactivity (hypersensitivity, paradoxical reaction, anaphylaxis); (*b*) lessened reactivity (hyposensitivity); (*c*) abolished reactivity (insensibility, immunity). The present writer points out that since both the hypersensitive state and the relatively immune state are easily proved to follow upon and to depend on infection, many people have assumed that the presence of hypersensitivity, loosely called allergy, implies the presence of immunity also. This, he proceeds to show, is an erroneous conception. Allergy in tuberculosis for him is the expression of an altered constitutional state of the body resulting from infection, a new state in which some individuals respond to a given amount of infection by becoming markedly hypersensitive to tuberculin, and yet may show little or no resistance if the infection develops into disease; while others, perhaps relatively less hypersensitive, may be highly resistant. The writer finds, indeed, that one of the principal functions of acquired immunity is to protect the infected individual from the effects of hypersensitivity. Summarising his paper, Cummins shows that man in his responses to tuberculous infection may exhibit in succession three main constitutional states: Indifference, intolerance and tolerance. The first of these is pre-allergic. A first infection encounters no immediate response except that of natural immunity. The states of intolerance and tolerance depend on the acquired character of allergy, or altered reactivity, which itself may be roughly subdivided as follows: (*a*) Allergic hypersensitivity, toxic and inflammatory processes resulting in exudation phenomena; (*b*) immuno-allergy, an anti-toxic stage evoked, at least in part, by reaction to the toxic products of the hypersensitive state; and (*c*) augmentation of natural immunity, probably stimulated by the phosphatide and other lipoid constitutents of the tubercle bacillus, and resulting in cellular proliferation, fibrosis and calcification of spontaneous healing. Further, there is reason to think that the toxic and inflammatory effects of allergic hypersensitivity are inimical to the initiation of the "productive" changes of the immune phase. This phase can only become established if and when the toxic process has been suppressed by the onset of the intermediate processes of immuno-allergy.

Some Clinical Aspects of Non-Tuberculous Allergy in Tuberculosis. By J. E. SHERMAN and O. E. EGBERT. *Amer. Rev. Tub.*, 1934, **30,** 561.

A few characteristic cases of allergy in tuberculosis are described in this paper, the cases having been selected at random among phthisic patients exhibiting allergic phenomena of any type. Analysis of the cases shows that desensitisation of the patient to his offending foreign protein does not influence the progress of the tuberculosis in any way, as indicated by X-ray picture, sedimentation records, monocytic-lymphocytic ratios and clinical examination. Another conclusion suggested by the study was that the administration of the so-called non-specific protein, in the ignorance of the existence of the inciting atopan, will sometimes cause activation of the allergy, but not of the tuberculosis. This was exemplified in two cases of asthma and hay fever respectively, which, having given negative reactions to food, pollen dust and other tests, were thought to be a bacterial type with a filtrable virus as the etiological agent. Non-specific protein therapy (peptone) was accordingly instituted, but with each administration the allergic condition became worse, although the state of their tuberculosis was unchanged. The writers conclude that acquired allergy has nothing to do with the immunity of the individual, and that acquired allergy is most prevalent in arresting cases of tuberculosis in which the immunity is greatest. The question as to the relation of the immunity and the original allergy that produces the tuberculin reaction is still open, but the writers suggest that the evidence brought forward in their paper leads to the belief that allergy and immunity in tuberculosis are one and the same.

The Time Interval between Primary Infection and Superinfection as a Factor in Immunity to Tuberculosis. By H. SEWALL, E. DE SAVITSCH and C. P. BUTLER. *Amer. Rev. Tub.*, 1934, **29,** 373.

In this paper the writers attempt to " represent the relations of allergy and immunity through a statistical study of tissue reactions due to superinfection following infection at various intervals of time." Two groups of guinea-pigs were inoculated with virulent tubercle bacilli in doses of 0·1 and 0·01 mgm. respectively, half the animals in each group being retained as controls. Six guinea-pigs in the first group were superinfected with the same dose after fifty-three days, and six after seventy-four days. In group 2, where the infecting dose was 0·01 mgm., the superinfecting dose was 0·1 mgm., and was administered at fifty-three, seventy-four and ninety-five days respectively to three groups of six guinea-pigs each.

The reactions of the various groups of animals were traced and compared according to six different categories: (1) The intensity of the " allergic " inflammatory reaction at the site of superinfection; (2) the local ulcerations of the skin as found at autopsy; (3) the presence of suppuration in the regional or other lymph glands as found at autopsy; (4) the survival period following infection; (5) the relations of body-weight to infection and superinfection and to lethal prognosis; and (6) classification of animal groups according to the visceral changes found at autopsy. The results were found to afford positive experimental evidence that superinfection has, under

certain circumstances, the power not only to increase fibrosis and thus to help to wall off foci of infection, but also actively to stimulate the bodily mechanism to resist the implantation of fresh foci of disease. A single variable in the experiments was shown to be of paramount importance in achieving resistance (immunity within the host), this variable being the time interval between infection and superinfection. The experiments indicated that at a certain period after infection the violence of the local reaction to reinfection begins steadily to diminish, but that, *pari passu* with this, the general stability of the reacting host, his power of adaptation and restoration—*i.e.*, his immunity—steadily increases. The local inflammation caused by superinfection at fifty-three days denotes allergy, and at this period the whole body probably shares the allergic state (as shown by disturbance of the animal's growth). In short, by withholding superinfection for stated periods, allergy diminishes but immunity increases. A note of warning is, however, sounded in the observation that the state of high immunity may involve local conditions of hypersensitiveness which carry peculiar dangers to the host. This was illustrated in the writers' experiments by acute multiple cavitation in the lungs.

Finally, the writers point out the bearing of these experiments on the elucidation of problems in human clinical tuberculosis, confirming both the value of rest in allaying active disease and the danger of ill-timed superinfections through premature exercise.

Experimental Researches concerning the Presence in the Body Fluids of Bactericidal Substances against Tubercle Bacilli, and their Significance for Immunity in Tuberculosis. By ERIK HEDVALL. *Acta Tuberculosea Scandinav.*, 1934, **8**, 102.

Investigations on this subject carried out by the writer at the Karolinska Institut, Stockholm, have conclusively shown the presence of bactericidal substances against tubercle bacilli in the body fluids, and determinations were subsequently made as to their properties and significance for immunity in tuberculosis. The two known bactericidal substances in serum are Buchner's alexin or α-lysin, and Pettersson's β-lysin. Bacteria which are α-lysin sensitive are *Strep. pyogenes*, *B. coli*, *B. typhi* and *paratyphi*, *B. dysenteriæ* and *paradysenteriæ*. Bacteria which are β-lysin sensitive include *Staph. pyogenes*, *B. anthracis*, *B. tetani* and *B. diphtheriæ*, and others. All Hedvall's experiments were made *in vitro*, using at first Arloing's homogeneously growing strain of human tubercle bacillus. By a method outlined in this paper, it was possible to ascertain that all the normal sera employed, obtained from man, horse, ox, dog, rabbit and guinea-pig, contained bactericidal substances against tubercle bacilli, a further series of experiments being then undertaken to ascertain whether this effect was due to the presence of α-lysin or β-lysin or to some other substance possessing bactericidal properties. These experiments proved that the effect could not have been due to α-lysin, and all the tests pointed to the probability that it was due to β-lysin.

Next, in order to learn how the bactericidal substances behaved in immunisation with tubercle bacilli, five dogs and five rabbits were immunised, for varying periods of time from a few months to more than a year, with unequal total doses of human tubercle bacilli, derived from different strains.

The immune sera produced in this manner were subsequently compared with respect to their bactericidal capacity with normal sera from corresponding animals. In no case were the immune sera more potently bactericidal than corresponding normal sera, being, indeed, in a few cases even weaker. Although, however, immune sera did not possess a greater number of bactericidal antibodies, they nevertheless exhibited an increased number of agglutinins and precipitins, antibodies promoting phagocytosis and promoting fixation of complement. The experiments have thus shown why immune sera—in both prophylactic and therapeutic tests—have proved to be ineffective in tuberculosis.

The same results were obtained in tests along similar lines with various members of the paratubercle bacillus group.

A Study of the Character and Degree of Protection afforded by the Immune State independently of the Leucocytes. By A. R. Rich and C. M. McKee. *Bull. Johns Hopkins Hosp.*, 1934, **54**, 277.

A highly developed state of acquired immunity is exhibited in two important ways: the fixation of virulent bacteria at the site of lodgment in the tissues, thereby inhibiting or even completely preventing the spread of infection; and in the second place, in the immune body the growth of the invading bacteria is suppressed, most of them being destroyed, and the body survives the infection. The first of these two effects has usually been ascribed to the mechanical walling-off caused by inflammation at the site of lodgment, but Rich, in a previously published paper, demonstrated the rôle played by immune antibody in immobilising pneumococci during the period before inflammation is well enough established to assist in preventing their spread. In the present series of experiments, immunised animals were treated with benzol to remove their leucocytes, and were then infected intradermally with virulent Type I pneumococci. It was found that in these immunised leucopenic animals the presence of immune antibody influenced profoundly both the character of bacterial growth and movement and also the course of the infection. The bacteria, as they proliferated, adhered to themselves and apparently to the tissues as well, being thus held fixed at the site of inoculation long after non-immune controls had died of septicæmia. The writers point out that since the phenomenon of immobilisation occurs in passively as well as in actively immunised animals, it is the antibody content of the fluid of the immune body which is primarily responsible for this prevention of the prompt spread of the bacteria. And although in the absence of leucocytes the growth of the immobilised bacteria may proceed to such an extent at the site of infection that at length penetration of the blood and lymph streams does occur, yet the presence of only a relatively few leucocytes at this site will result in the ingestion and destruction of the bacteria opsonised by the antibody, and thus sterilising the lesion. The humoral antibody, therefore, has, in addition to its opsonising power, the property of holding the bacteria fixed at the site where they lodge until the phagocytic leucocytes are able to do their part. Finally, the writers point out that it is " the humoral antibody which, with the co-operation of the intravascular phagocytic macrophages of the liver and spleen, brings about the rapid segregation and

destruction of bacteria which do penetrate into the blood," thus further inhibiting metastatic infection.

The Relation of Allergy to Immunity in Tuberculosis. By H. ROTHSCHILD, J. S. FRIEDENWALD and C. BERNSTEIN. *Bull. Johns Hopkins Hosp.*, 1934, **54**, 232.

Until recently the assumption was made that acquired immunity in bacterial infections in general and in tuberculosis in particular is dependent upon the hypersensitive state, and that both the inhibition of spread of bacteria and their successful destruction result from the accelerated and exaggerated local inflammation which characterises the local reaction of the allergic body to the presence of the tubercle bacillus. The work of Rich and others has abundantly proved that these theories are not necessarily or even probably true, and that in any case allergy does not parallel immunity. The experiments described in this paper were carried out in order to ascertain definitely whether or not immunity in tuberculosis is impaired by the abolition of allergy. The experiments showed that when desensitisation is accomplished by a very gradual increase in the dosage of tuberculin, guinea-pigs can tolerate for weeks enormous daily doses of potent tuberculin; and that if these huge doses are continued daily after reinfection with virulent bacilli, hypersensitiveness never reappears. If desensitisation is attempted by too rapid increase in dosage of tuberculin, the animals will waste and die; and if reinfection is performed before desensitisation is complete, hypersensitiveness will return. The effects of intradermal inoculation of living virulent tubercle bacilli showed no evidence of allergy in a group of desensitised animals, but classical signs of allergy in both untreated and glycerine-treated allergic groups. The general course of the skin infection was less severe in the desensitised than in the allergic animals, the desensitised animals also apparently having a greater power of fixing the infection locally at the site of injection. In another series of experiments, injections were made into the eyes, the findings here being in accord with those in the other organs. There was no evidence that the loss of allergy deprived the immunised animal of any aspect of his immunity so far as concerned the progress of local lesions; on the contrary, the local ocular lesions in the desensitised animals were more circumscribed, less severe, and less rapidly progressive than those in the immune allergic animals.

The conclusions to which these authors arrive include, therefore, the following: Complete desensitisation to tubercle bacilli and to tuberculin can be achieved in tuberculous guinea-pigs by a prolonged and properly graded course of subcutaneous injections of Koch's O.T. Long-continued daily subcutaneous injections of massive doses of concentrated glycerine broth in some instances desensitise guinea-pigs to tuberculin. This non-specific desensitisation is not due to the glycerine contained in the broth; and it is not known whether it is free from the danger of perifocal reaction. In so far as the inhibition of spread of lesions from the site of infection to the viscera may be used as evidence of local fixation of bacilli, the desensitised non-allergic immunes were able to resist the spread of infection as successfully as the allergic immunes. The experiments have therefore confirmed the conclusion of Rich and other workers that immunity in tuberculosis is not impaired by the abolition of allergy.

REVIEWS OF NEW BOOKS

The B.C.G. Vaccine. By K. Neville Irvine, D.M., B.Ch. Oxon., Hon. Phys. to Henley War Memorial Hospital. Pp. 70. 1934. Price 5s. London: Oxford University Press.

No one interested in tuberculosis can afford to be without this little volume. Not only does it give an unbiassed account of the present position of B.C.G., but full references are given at the end of each chapter, so that the reader can look up the original accounts of the numerous experiments that have been undertaken and the controversies that have raged about them.

The Lubeck and other lesser disasters are described, and it seems clear from the evidence that B.C.G. cannot be held responsible. Many experiments have been made to decide whether it returns to virulence in man, animals or in vitro, but they are not conclusive and there is no doubt that many thousands of children have been inoculated without harm, although it has occasionally produced progressive tuberculosis in laboratory animals.

When one turns to the good that B.C.G. may do the evidence again is unsatisfactory. There is no doubt that it does give some partial and temporary resistance, but the claims that have been made for it (notably that it reduced the mortality in infants from 25 to 1) are exaggerated.

The author concludes that B.C.G. should be given to children in tuberculous families and research organised to decide the degree of immunity it produces.

Annual Report of the Chief Medical Officer of the Ministry of Health for the Year 1933. Price 4s. 6d. H.M. Stationery Office.

In 1912 a special committee, under the presidency of Lord Astor, designed a scheme for a national attack on the problem of tuberculosis. Tuberculosis officers in charge of clinics or dispensaries were appointed and the sanatorium principle extended, so that there are now 26,773 sanatorium beds in the country as compared with 5,700 in 1911. There are some 380 tuberculosis officers and 459 dispensaries. Modern methods of treatment, chief amongst which is collapse therapy, have prolonged many lives, but perhaps the principal advance is in prevention, which is the chief concern of the dispensary unit.

The result of this work is well shown in Appendix B, which deals with tuberculosis. In the years 1901-1910 the annual death-rate per million living from pulmonary tuberculosis was 1,143 and from non-pulmonary tuberculosis 503. In 1933 these figures were respectively 639 and 160, or a fall of 44 per cent. and 80 per cent.

For every 100 deaths		1901-1910		80 occurred in 1933 from all causes.
,,	,,	,,	,,	56 occurred in 1933 from pulmonary tuberculosis.
,,	,,	,,	,,	20 occurred in 1933 from non-pulmonary tuberculosis.
,,	,,	,,	,,	111·6 occurred in 1933 from cancer.

These figures suggest most strongly that general hygienic improvements, which have lead to a decrease in the death-rate from all diseases, cannot alone account for the fall in the tuberculosis death-rate. That they have played some part, and a big part, in this improvement is probable, but there are other factors. From the report one must regard sanatorium and other institutional treatment as justified. The cost of such treatment is enormous, but one must judge its results more by its effect in prevention—that is to say, in decreasing the incidence of tuberculosis—than by its effect in saving or prolonging life of the individual consumptive.

The suggestion that the prevalence of influenza early in 1933 checked the fall in death-rate from tuberculosis needs proof. In the big epidemic of 1918-19 the death-rate from influenza was enormous and out of all proportion to any change in that from tuberculosis, and in those years when there is an epidemic of influenza there is not a corresponding increase in tuberculosis. Those who are weakly from heart, kidney or any other disability, including tuberculosis, are less able to withstand an acute infection such as influenza, but that this disease activates tuberculosis is, we suggest, still a matter of doubt. Some interesting figures are given regarding the acute phase of the disease so common in young adult women, and there is need for further research not only for the treatment but for the causes of this condition.

Tuberculosis forms but a small part of the report, which is mainly concerned with the general health of the nation, and the incidence of illness and death from all diseases and accidents, and no one can fail to find interest in it.

Prevention and Treatment of Tuberculosis in the Administrative County of Lancashire.

We look forward each year to the report of Dr. Lissant Cox, whose work is so well known, and this year it more than fulfils one's expectations. Here will be found an account of the activities of the dispensaries in the different areas and sub-areas and of the sanatoriums. The treatment that has been employed and its results are fully set out, and indicate that Lancashire is amongst the leaders of progress in the treatment of tuberculosis.

Dr. Lissant Cox pleads for unity in the administration of the scheme to attack the disease. To his mind it is wrong to find the dispensary or preventive unit under one authority and the sanatorium or treatment unit under another. The dispensary, he says, should contain an X-ray apparatus, and have facilities for giving pneumothorax refills, and be thoroughly up-to-date; the officer in charge should also be in charge of a hospital with 50 beds for every 200,000 population in a rural and 300,000 in an urban district.

The hospital or sanatorium should admit all cases, the early and advanced, those requiring collapse or other special treatment and those for observation. A well-equipped dispensary will prove an economy by making diagnosis accurate, and thus saving a number of beds required in hospital for diagnosis of doubtful cases.

In the administrative county of Lancashire, one bed is found sufficient for pulmonary tuberculosis for every 7,560 of the child population from 0 to 15 years of age, the corresponding figure for England and Wales being 4,345. Children who were examined as suspicious but rejected as non-tuberculous did not subsequently tend to develop adult tuberculosis. Thus out of 3,556 young adults with definite tuberculosis, only 30 had been rejected in childhood as not suffering from pulmonary tuberculosis.

Dr. Lissant Cox does not think it necessary to overburden the work of the dispensaries by continuing to supervise those patients who have made a complete recovery as far as it is humanly possible to tell. He found that of patients who had had tubercle bacilli in the sputum but had recovered and been written off the register, only 3·2 per cent. returned with a relapse.

An interesting chapter deals with the after-histories of adults with pulmonary tuberculosis, and although it is perhaps somewhat early to judge the effect of modern collapse therapy, the results of treatment are disappointing, but, as is pointed out, one must remember how much of the work is directed towards prevention, in which institutional treatment plays a big part. For non-pulmonary tuberculosis the results of treatment are most encouraging, 70 per cent. of adults and 80 per cent. of children having recovered.

The report is a fund of valuable information, and amongst other features includes the following special articles:

"Actinotherapy at a Tuberculosis Dispensary," by Dr. Jessel (pp. 17-23).
"Artificial Pneumothorax: A Survey of Sixty-four Cases with Controls induced at Rufford Pulmonary Hospital," by Dr. F. C. S. Badbury (pp. 24-33).
"Inhalation Therapy in Pulmonary Tuberculosis by the Apneu Collison Inhaler," by Dr. G. Barker Charnock (pp. 34-38).
"Gold Therapy," by Dr. G. Leggat (pp. 118-120).
"Artificial Sunlight in the Treatment of Pulmonary Tuberculosis," by Dr. G. Leggat (pp. 116-118).
"Hydrocarpates in the Treatment of Lupus Vulgaris," by Dr. J. Edgar Wallace (pp. 39-41).

La Tuberculose Pulmonaire et les Maladies de l'Appareil Respiratoire de l'Enfant et de l'Adolescent. By P. ARMAND-DELILLE and C. LESTOCQUOY, with the collaboration of RÉNÉ HUGUENIN. Pp. 499. 1934. Price 375 francs. Paris: Amedée Legrand.

As Professor Calmette says in the introduction, never before has so monumental a work on childhood tuberculosis been published. The authors must indeed be congratulated on a great book beautifully illustrated and produced, and presenting clearly the modern theories and facts on the present state of knowledge of this subject.

In France infantile tuberculosis generally originates from contact with some tuberculous member of the family, and infection through the alimentary tract is rare. Investigation of a case should include:

(1) Family history.
(2) Mantoux or Von Pirquet tuberculin test.
(3) Radiography.
(4) Examination for the tubercle bacillus in the gastric contents as well as in the sputum and fæces.

We are told that Parrot's or Ghon's tubercle is not in reality a primary focus, but occurs by virtue of the allergic state, or in other words that it is a manifestation of Koch's phenomenon.

Infantile and childhood tuberculosis are by no means universally fatal as was formerly supposed, and both the primary infections and reinfections are often curable. That this must be so is obvious, since tuberculin tests have shown how many get infected in infancy without showing any signs or symptoms of ill-health.

The success of treatment in these young patients is often remarkable, and the authors have treated young children with success not only by artificial pneumothorax but by bilateral pneumothorax, and in many cases it has been possible to render an incomplete pneumothorax complete and to close a cavity by cauterisation of adhesions. The presence of cavities and the adult type of tuberculosis would appear to be less uncommon in early childhood than is popularly believed.

Although the success of pneumothorax is so great, other methods of collapse therapy in the child have proved disappointing. The authors believe that phrenicectomy may be tried, but only if pneumothorax is impossible owing to adhesions. Thoracoplasty is an operation which should be reserved for adults or at least adolescents, but they mention one case where thoracoplasty was performed with success.

The last part of the book deals with non-tuberculous conditions of the lung. In cases of bronchiectasis they regard simple medical methods of treatment, possibly with injections of lipiodol, as best; pneumothorax is disappointing and thoracoplasty collapses the healthy lung rather than the dilated bronchi. Lobectomy has the advantage of removing the diseased lobe, but they point out that the operation itself is still one of much danger.

Referring to the treatment of lung abscess, the authors stress the danger of treating the acute abscess by other means than simple medical. If the abscess becomes chronic, surgical intervention may be required, but as a rule the prognosis in an acute abscess in childhood is good.

The book contains 352 excellent radiographs, each one being accompanied by an explanatory diagram. At the end will be found a table of contents, an index and a list of references. The work is a classic and can be warmly recommended to all interested in tuberculosis or diseases in childhood.